# SCIENTIFIC AMERICAN

FEBRUARY 1928 ★ *Thirty-five Cents a Copy*

## TESTING TRANSATLANTIC MOTORS

By T. H. ("DOC") KINKADE

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# 57

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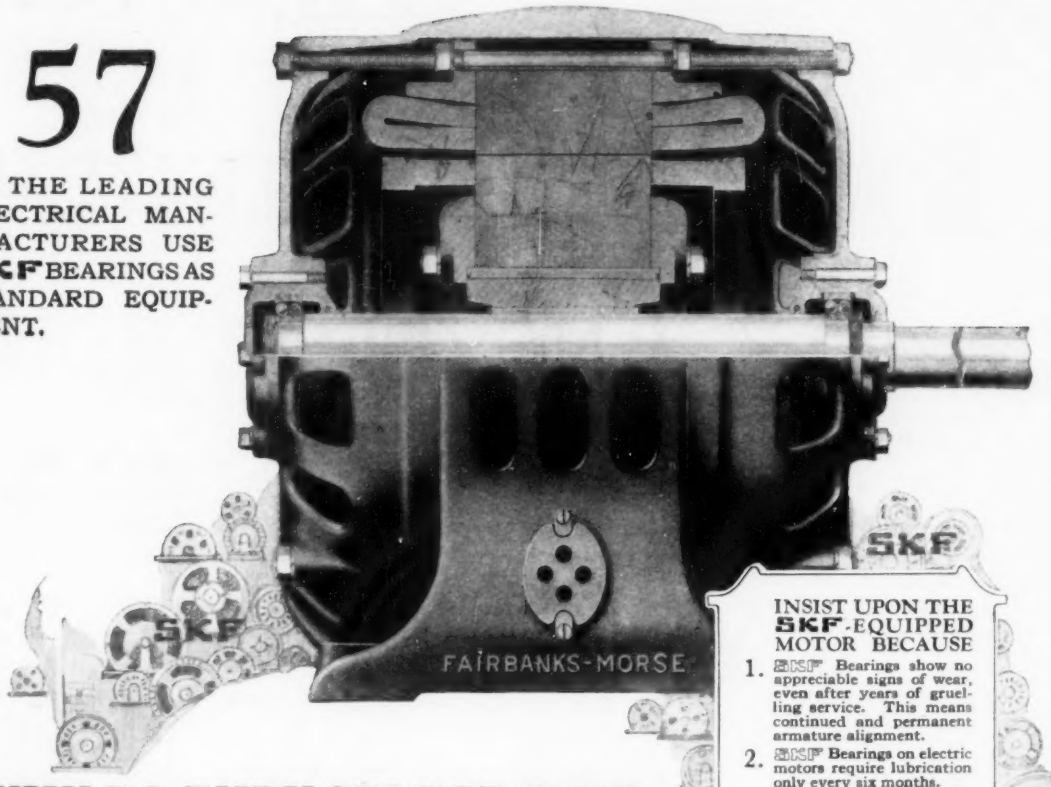


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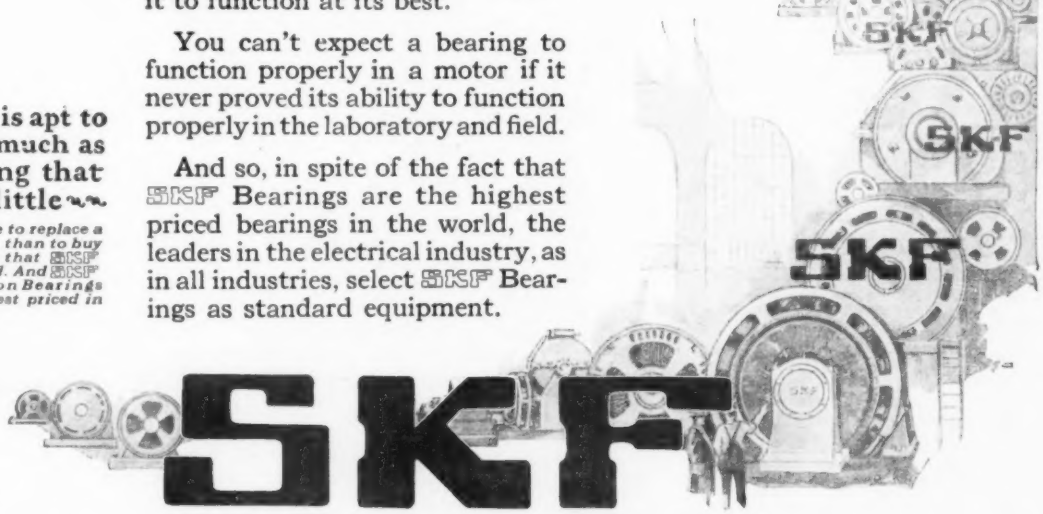


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Please accept my congratulations on the one hundred and sixtieth anniversary of the founding of the Encyclopaedia Britannica. This publication has exerted a most profound and far reaching influence on education throughout the world and has performed a service of inestimable value in making readily available such an accurate and comprehensive body of knowledge.

*From* Sir Robert Borden, *Ex-Premier of Canada:*

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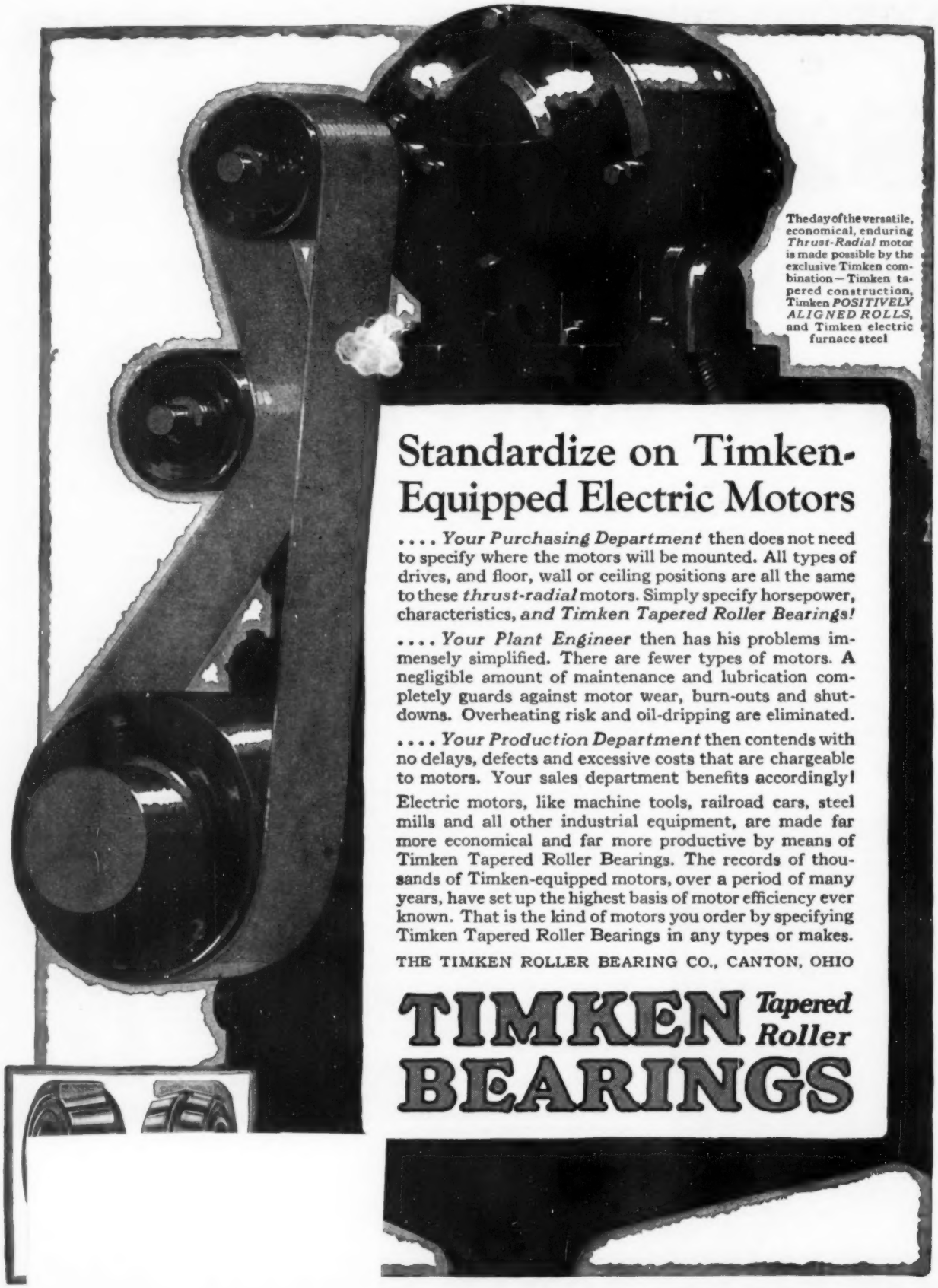

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# SCIENTIFIC AMERICAN

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### COVER

Imbued with the spirit of Mr. Kinkade's article starting on page 105 of this issue, our artist, Howard V. Brown, has transferred to colors all the action and thrill of aerial flight. The plane which he took as his model is equipped with the same type of motors as those spoken of in the article mentioned.

# Why these NATIONALLY KNOWN Industries Came to Los Angeles County—

*Administration building GOODRICH rubber plant, open March, 1928. 1500 employees.*

NATIONAL BISCUIT COMPANY, *Pacific Coast plant, opened 1926.*

GOODYEAR *rubber factory, 2200 employees. Textile Mills, 600 employees.*

SEARS, ROEBUCK & CO. *serving Utah and Pacific Southwest, employing capacity 1800, opened July 1927.*

**JOHN W. MAPEL,** *President*
**GOODYEAR TIRE & RUBBER CO. OF CALIFORNIA**
"Southwestern cotton, for our tire fabric, and rubber from the Far East drawn through Los Angeles Harbor, could be brought together in Los Angeles County at low cost of transportation and with favorable labor efficiency, for serving our entire Western trade."

**S. B. ROBERTSON,** *Vice-President*
**PACIFIC GOODRICH RUBBER COMPANY**
"We were drawn to Los Angeles County with our Pacific Coast factory by its large local market for our product, its unsurpassed labor situation and excellent distribution coastwise and by rail, to the eleven Western States."

**RUSSELL A. FIRESTONE,** *Vice-President*
**FIRESTONE TIRE & RUBBER CO. OF CALIFORNIA**
"Mr. C. A. Myers our Director of Engineering selected Los Angeles County for the new Firestone factory because of its central location, excellent railroad and shipping facilities, abundance of water, and most favorable labor conditions."

**C. M. KITTLE,** *President* **SEARS, ROEBUCK & COMPANY**
"Los Angeles County and Southern California contain the largest industrial production and retail markets in the West, which, with the rapid growth of population, naturally attracted our mail order house and retail stores."

**F. F. BARKOW,** *Manager* **NATIONAL BISCUIT COMPANY**
"Our plant for serving the bakery goods trade of the entire Coast is well located in Los Angeles County for assembling all raw material, heavily bought on the Coast, and in the center of the largest consuming market for our products, with economical deliveries to our Western sales branches."

---

**NATIONALLY known manufacturers have invested $27,000,000 and local manufacturers, $15,000,000 —a total of $42,000,000 new capital for factory expansion and development in Los Angeles County during 1927. The Great Western Market thus continues to attract industry—Specific information furnished by Industrial Department, Los Angeles Chamber of Commerce.**

*First unit, FIRESTONE Rubber Factory, to employ 1750 persons.*

INDUSTRIAL LOS ANGELES COUNTY

# Looking Ahead *With the* Editor

### Vibration and Heat

SOUND BURNS! A thin thread of glass no larger than a hair, vibrating at the rate of 300,000 times a second, leaves a groove with seared edges in the flesh when pinched tightly; it burns its way through a piece of wood, leaving a charred hole. Look for the article on vibration and heat, coming soon, by Professor R. W. Wood of Johns Hopkins University. It contains valuable information of a surprising nature.

### The Secrets of Kish

AFTER being fortunate enough to find a stamped brick that settled the question as to the location of this seat of the first empire known to history, the Field Museum-Oxford University Expedition uncovered some interesting things. In an article to appear soon, many facts will be revealed, concerning the life and culture of the founders of this ancient Sumerian city.

### Mind and Muscle Co-ordination

READY for release: an article by Dr. Walter Miles, psychologist, primarily concerning the speed of charging football players, and including reports on the "personal equation" experiment, the quickness of the hand, and the reaction time of groups of men. In this account of experiments performed, you will find that 120 thousandths of a second is sometimes fast; and then, again, not so fast. It is an index to human reaction-time.

### Gravitation and the Earth's Weight

WHEN does gravitation act sidewise? How are its laws utilized in weighing the earth? Is the earth "transparent" to its forces, or is there some screen that can be used to counteract it? How great is the pull between two bodies such as, for example, two steamships docked side by side? The answers—with many interesting comments and sidelights—are coming shortly, in an article by Dr. Paul R. Heyl, physicist.

### Grooming

"DOC" KINKADE'S curry-comb and brush for the thoroughbred of the air, the Wright "Whirlwind," are wrench and screw driver. With these tools and a fine knowledge of airplane engines, gained by years of experience, he tunes them up so they'll get where they're going. There is a lot to this job of tuning and testing, as you will see from his present article and from the coming one to appear next month.

***Every Issue Fully Illustrated***

*¶ To keep abreast of the times, you must keep pace with the advances of science. For only four dollars, the* SCIENTIFIC AMERICAN *will keep you informed of the latest happenings in the world of science for a period of twelve months.*

# *Among Our* Contributors

### T. H. ("Doc") Kinkade

In the case of Mr. Kinkade, "the man behind the gun" might aptly be paraphrased as "the man behind the transatlantic flights." Starting as an apprentice tool-maker, he has advanced by degrees through combustion engine manufacture and airplane engine installation, to the position he now holds as superintendent of the Wright Aeronautical Corporation. He first gained public notice when he installed the motors on the first three-motored plane in Holland, in 1925.

### Professor Josephine E. Tilden

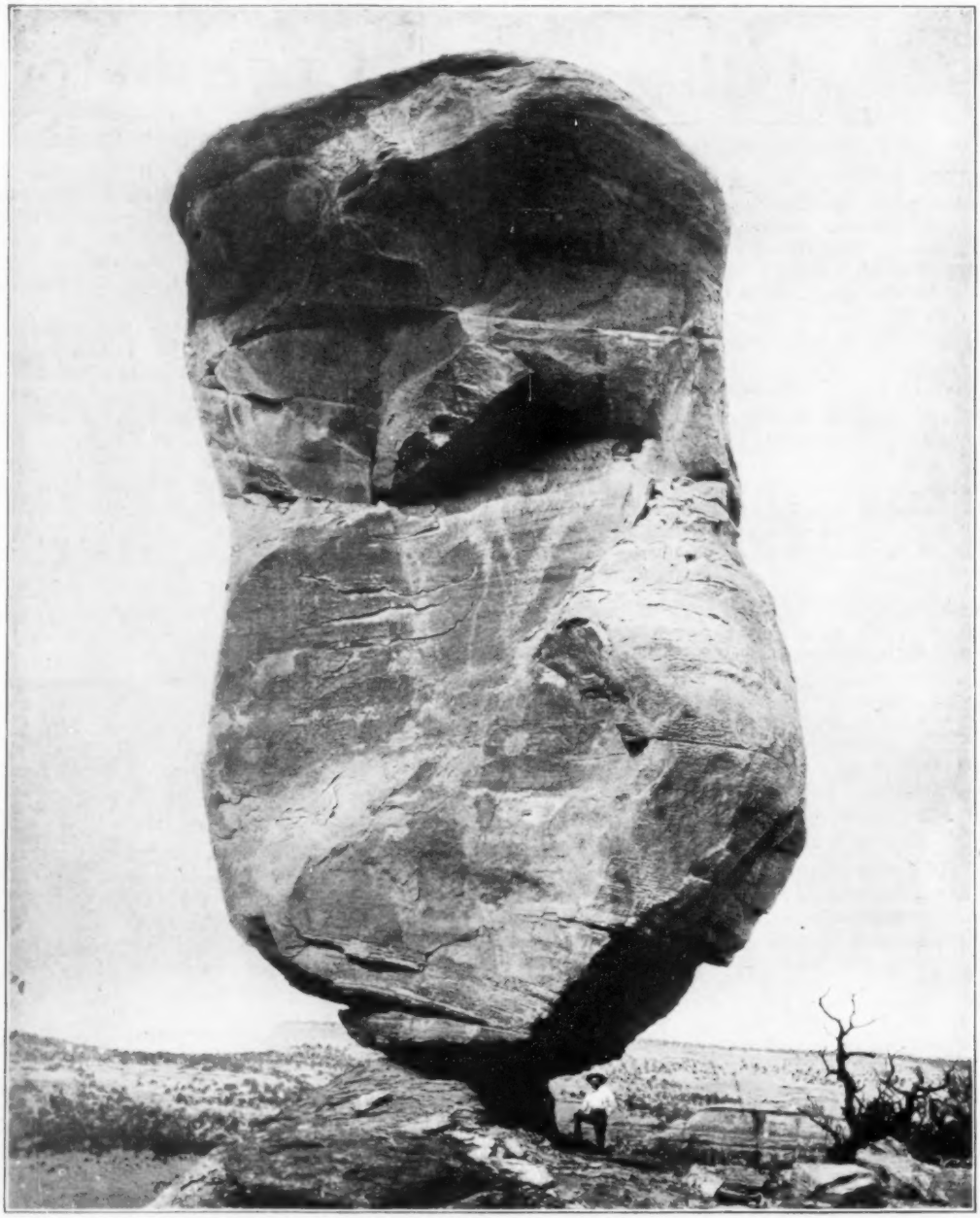
Seven years of research at the Minnesota Seaside Station on Vancouver Island, and several years spent on many Pacific islands in close study of the relationship between the algae and other organisms, gives Professor Tilden the finest kind of authority for her facts—personal experience. Her researches may lead to the initiation of investigations having great economic importance.

### Professor Bailey Willis

Among geologists Bailey Willis is noted for his extensive record of work on earth structures, such as mountain ranges. Beginning his career as geologist for the Northern Pacific Railroad in the early Indian days when the scientist frequently had to drop science and take up a rifle, he served 32 years with the United States Geological Survey. He has received many notable awards and honors, is a member of many scientific societies, and now professor emeritus of Stanford University.

### Paul Griswold Howes

Mr. Howes, Curator of Natural History in the Bruce Museum, Greenwich, Connecticut, has spent much time in tropical countries investigating zoological problems. In 1928 he expects to make another trip to Dominica for the further study of bats. Author of "Insect Behavior" and "Backyard Exploration;" co-author, with Messrs. Beebe and Hartley, of "Tropical Wild Life."



## Miracle Rock, in Colorado

ONE of the largest balanced rocks in the world is Miracle Rock near Grand Junction, Colorado. Towering over 75 feet above its small base, it stands on the very brink of a cliff overlooking the valley of the Little Dolores River, in Glade Park. Occasionally balanced rocks are of a piece with the strata on which they rest, the "neck" between the two often being due to aeolian or wind-blown sand erosion. Generally, however, they are glacially transported boulders deposited in precarious positions by the ice. Of these a few have happened to come to rest in such a position that, massive as they are, a child can teeter them. Miracle Rock may stand a few more thousands of years but in a short time, geologically speaking, will go crashing to the valley below. From the appearance of the picture let SCIENTIFIC AMERICAN readers estimate its weight.

THE PLANE THAT ENCIRCLED THE NORTH POLE

*Fokker airplane, Josephine Ford, used by Commander Richard E. Byrd on his hop from Spitzbergen to the North Pole and return. The three Wright "Whirlwind" engines used on this plane were tuned up by "Doc" Kinkade prior to the take-off for the Pole*

# Tuning Up Transatlantic Motors

## *Airplane Engine Expert Tells About the Rigid Tests Necessary Before Take-off*

By T. H. ("DOC") KINKADE

SHORTLY after midnight on June 29th a calm, even cheery voice came over the wire to me in my room at the Garden City Hotel, near Roosevelt Field, Long Island.

"If you're ready, Doc, we're going at dawn."

It was the voice of Commander Richard E. Byrd, the daring airman whom I had seen take off from the shining snows of Spitzbergen for his flight over the North Pole, and now he was announcing that in a few hours he would be on his way to Europe in the first multi-motored plane ever to span the Atlantic.

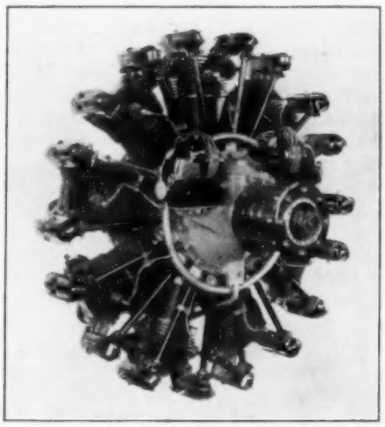
I was surprised at his announcement; in fact I was thoroughly shocked, for the weather report at 11:30 P.M., just a few minutes before, had shown anything but ideal conditions over the Atlantic, and I had gone to bed confident that the *America* would not leave for 48 hours at least. And I knew no other weather report had come in the meanwhile.

I made bold to mention this to Commander Byrd, but he replied in the same gentle voice:

"WELL, Doc, we're not looking for ideal weather. All we want is an even break. So, if the engines are O.K., we'll take off as soon as it gets light."

The engines were O.K. They were absolutely perfect. I had turned them over a few hours before, and I could not detect the slightest off-color note.

However, I now knew that with the prevailing weather conditions they would be subjected to a terrific test. So I jumped into my clothes and rushed out to Roosevelt Field to take advantage of every possible second for one last inspection, for it was up to me to give the final O.K. on the engines before the start.



A WRIGHT "WHIRLWIND"

*Front view of the type and make of engine made famous by the 1927 transatlantic hops*

While the great plane was being filled with gasoline and oil, I went over the power plant with as great care as time permitted. A thorough inspection, of course, takes many hours, but such an inspection had been made just a few days before, and I now devoted myself to the more obvious details.

EVEN before I started I knew everything was O.K., because for weeks I had kept my eye on every possible source of trouble; but in aviation mechanics, one has to be absolutely certain. I had not only the responsibility for the proper functioning of the engines produced by my employers, the Wright Aeronautical Corporation, but I also held in my hands the lives of four of my dearest friends, Commander Byrd, Lieutenant George Noville, Bert Acosta, and Berndt Balchen. If the engines quit in midair, the chances of life were slim for these daring airmen; for no plane can be better than its power plant.

And so in my inspections I also included the fuel and lubrication systems, for gas and oil are the blood of the plane. Of course, the best motor in the world is worthless for flying purposes if it is not properly supplied with gas and oil. So I carefully inspected all the feed lines, making sure that they were in perfect

condition, that all the cocks worked, and that there was no evidence of leaks.

The Byrd plane, by the way, was provided with a double fuel system, so that if one failed, the other could be turned on. And the gas was fed to the motor by gravity from wing tanks, to which it had been pumped from the big tank in the fuselage. So there was considerable lineage to inspect.

Next I took a glance at the carburetor. It looked all right. Then, one by one, the engines were set in motion, and I gave them the tests which I will describe in my next article.

THE best motor test of all is its sound to the experienced ear. And each of the Wright "Whirlwind" motors answered the sound test perfectly on that chilly June morning a few minutes before the take-off. There was that sweet and familiar bass monotone which indicated that every cylinder was operating as it should be. What a marvelous thrill of power those humming deep-throated notes gave me! Not a single variation, not a single miss or sputter.

I listened as a physician listens with his stethoscope to the heartbeat of his patient. And just as the doctor is familiar with the normal sound of the heart and is alert to every departure from the normal, so was I "on my ear," so to speak, to catch the slightest sound which would indicate a trace of motor trouble.

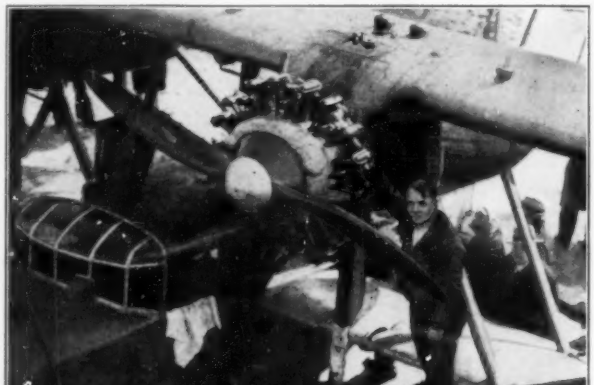
And although I have been listening to airplane engines for 16 years, having begun with the Wright brothers, I have never heard sweeter, truer motors than those three "Whirlwinds" just before they started to zip their way across the ocean to France.

I told Commander Byrd everything was O.K.

I knew those motors would make it. I knew they would take the load, and more too. I was so certain of it that I suddenly got a hankering to go along. I wanted to hear those three engines roar all the way across the sea. So I crawled into the plane and tried to make myself as invisible as possible in the half light of breaking day. But just then I heard Commander Byrd say he was throwing his container of tea overboard to lighten the load just that much.

Well, if the Commander was foregoing his precious tea just to lighten up the plane a few pounds, I decided I would not jeopardize the lives of my four friends by stowing away my personal tonnage. I believed, and I still believe, that I could have made the trip without jeopardizing the success of the venture; but I knew that plane *had* to get across, and I was not going to give it any extra handicap. It would have been a fine trip, but I preferred the satisfaction of knowing that every transatlantic motor with which I had been associated had come through successfully.

I was associated with the tuning up of all the planes which made non-stop flights from the mainland of America to the European continent. There were three of us working on the *Spirit of St. Louis:* Messrs. E. J. Mulligan, K. J. Bodecker, and myself—because all the testing had been done on the Pacific coast and we wanted to give the engine the final once-over in as short a time as possible. Most of the tuning of the *Columbia* and the *America* fell to me.



"DOC" KINKADE IN WORKING CLOTHES

*We had a hard time unearthing this picture. The author did not remember having one—always too busy while working to have pictures taken*

I do not say this in any spirit of boastfulness, or in the spirit of seeking any credit for myself. These jobs merely fell within the scope of my regular duties as service engineer. I am happy that the turn of circumstance gave me the privilege of inspecting those motors, although I will admit frankly that the responsibility was not exactly conducive to sound slumber o' nights. However, there was no time when I felt any lack of confidence in the motors. I believed that they were as nearly perfect in material and workmanship as it was possible for human hands to make them.

THE credit for the remarkable Wright "Whirlwind" engine belongs to its inventor, Charles L. Lawrance, and to the high degree of skill of the workmen who build them so carefully that a minimum amount of tuning up is required from those who comprise the service department.

So I, whose task it was to see that the engines were ready for their strenuous test, was in the position of the physician who examines a physically perfect patient.

But in order to see just what this tuning up is all about, let us go back a little and investigate the relation between plane and power plant. Naturally this relation must be close. There must be a blending and coordination between the plane, which may be compared with the body of a human being, and the engine, which corresponds to the heart. The motive power must be strong enough to lift the plane and maintain it in flight; at least such is the case in a simple plane which is made only to achieve short flight. But when we begin to build heavier-than-air flying machines for specific purposes, there are other elements to be considered.

FOR example, when we set out to build a transatlantic plane, the essential factor is a power plant which will lift and fly a tremendous load of fuel and equipment for 4000 miles. Naturally the plane itself is so designed as to render the work of the engine more efficient. The body is streamlined, and every effort is made so to shape all the parts that they offer a minimum resistance to the wind. Wing spread and wing thickness are calculated to give maximum sustaining power. There must be a close inter-relation between the design of the plane and the work it will be called upon to perform. So with the engine.

After the ship is constructed, there must be various tests aimed to coordinate plane and engine to insure not only harmonious but economical operation; for it is highly important on oversea hops that the engine should be operated to produce a maximum of power in relation to fuel consumption.

So there must be accurate fuel-consumption tests at various speeds, and weight-lifting tests to determine if the plane can lift and carry fuel and equipment for the requisite number of miles.

All the transatlantic planes underwent these careful tests, and I happened to be associated with some of them.

The important fuel-consumption test is comparatively simple. For this test a graduated fuel tank is placed in a convenient spot in the cabin where it can be watched. This tank is usually arranged so that it can be refilled in flight, to avoid several landings.

The plane is then put over an accurately measured course determined

by two fixed points. It is run with the wind and against the wind to find the average speed. And careful check is kept on the gasoline.

This course is run several times at various engine speeds to determine fuel consumption at each speed; for in every combination of plane and engine there is a definite engine speed which will give the greatest number of air miles per gallon of gasoline. Often the most economical speed is less than the maximum speed.

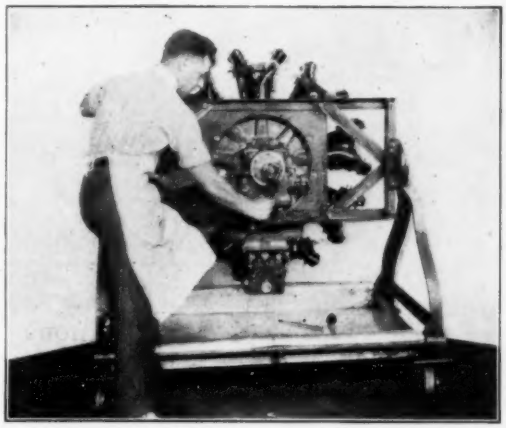
After fuel consumption is known, it is a simple arithmetical calculation to arrive at the weight of fuel the plane must carry for its trip. Then the load tests begin. These tests are conducted by adding definite weight instalments until the desired approximate weight is reached. With each load it is again necessary to watch both speed and fuel economy to determine how various weights affect these two vital factors.

IN making provisions for fuel, due allowance must be made for wind conditions over the route of the proposed expedition. For instance, if the plane runs through an average 20-mile head wind for 50 hours, it loses 1000 miles. It is for this obvious reason that a transatlantic plane must await proper weather conditions, usually with a tail wind. But the time is not far distant when planes will be built to defy the weather. They will be able to carry sufficient fuel to take them through strong head winds.

It is also necessary to get the proper propeller in relation to plane and engine. Experiments must be made with various types. Often a propeller which will give maximum speed in the air is not the most efficient for taking-off, and the actual take-off is a highly important and dangerous part of a long flight. It is no small matter to lift a heavily laden plane from the ground. The take-off brought disaster to the Fonck plane, the first ever to attempt the non-stop New York to Paris flight.

All the necessary tests and the wait for reasonable weather conditions take time, and in the case of one transatlantic flight the public became very impatient. Personally I was rather angry at this attitude for I knew the difficulties under which the personnel of this flight was working, and I realized the importance of the success of this flight. The public did not understand what we were up against, and apparently was interested only in the "show." This flight was privately financed. The members of the crew had already made sacrifices, and were about to risk their lives. Yet the average man, knowing little about the problems of transatlantic flying, unjustifiably criticized the delay. This attitude had a trying effect on all those connected with the flight, and I know that I must have been irritable along about this time.

Another feature of the preliminary tests about which the public knows little is the thousand and one salesmen who want their accessories used on the plane. Each insists that his product is best, and offers all sorts of inducements to have it play a part in the historic flight. I have been offered as much as 10,000 dollars to recommend to my employers the installation of a certain product.



**DETACHED**

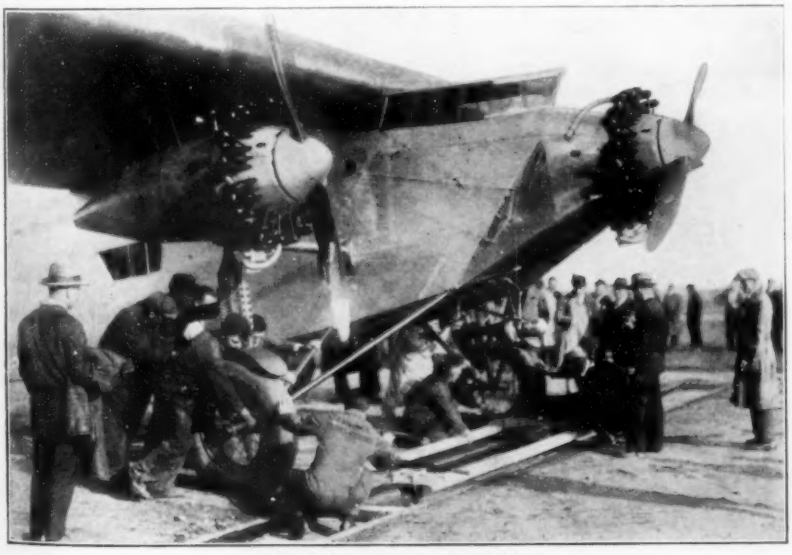
*Rear view of a Wright "Whirlwind" engine showing rear crankshaft gear being removed. The crankshaft is connected, without intermediate gearing, directly to the propeller in front and to the oil and fuel pumps in the rear. Compare size of this powerful unit with that of the workman*

BUT every accessory used on the plane must meet the most rigorous test, and must have stood the test of time. This is not the time for experiments; for here the future of aviation and human lives are at stake. Often the salesman is sure that his is the best device; and perhaps it is. By itself it may meet many tests satisfactorily, but in this case an instrument must be judged not by its individual performance but by its performance in connection with other parts of the whole.

For example, if a "Whirlwind" engine is selected as the power unit, the accessories must be those which will give the best results with the Wright engine; and it is certain that different accessories will give different results in various combinations. The proper combination is determined by trial, and no equipment is accepted until it has proved itself.

After each test flight, of course, the plane and engine are carefully inspected. A thorough inspection of the whole plane requires from 36 to 48 hours. And once this inspection is started it must go on to completion without a halt, because if the inspector's attention is taken away at all, some part may be overlooked.

*(To be Continued)*



**THE ILL-FATED *AMERICA***

*Lining up and inspecting the landing gear of the giant plane in which Commander Byrd made his memorable flight from Long Island to the coast of France, and which ended disastrously*

ONE METHOD OF ACCESS TO VIRGIN COUNTRY

*The explorer in Central America will find transportation his chief obstacle. Dugout canoes painfully poled up the swift streams furnish one method of penetrating within striking distance of the objective, usually situated at a point far inland from the coast*

# In Quest of Ruined Cities

## *How the Scientific Explorer Penetrates the Dense Tropical Forests of Central America in Search of New Evidence of a Vanished Civilization*

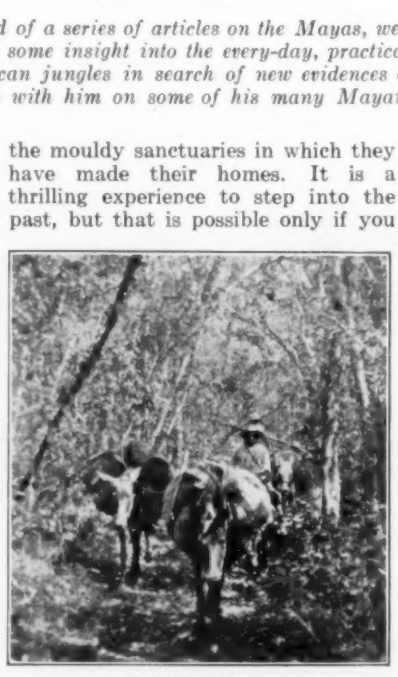
By HERBERT J. SPINDEN

*Curator of Mexican Archeology and Ethnology, Peabody Museum, Harvard University*

¶ *For this, the second of a series of articles on the Mayas, we have asked Dr. Spinden to give our readers some insight into the every-day, practical methods of penetrating the Central American jungles in search of new evidences of the past. He has accordingly taken us with him on some of his many Mayan journeys.*—The Editor

ENCHANTED barriers protect the silent cities of the Mayas from molestation; coral reefs guard the coast; logwood swamps block the road; and all but impenetrable jungles screen the view. Yet one by one the spells are being broken while science wins an inner knowledge of the most splendid civilization of ancient America. Briefly, I wish to tell how explorations are conducted in old Mayan territory, the account being based on my own experiencies, but illustrative of common practice.

If living an exposed life be adventure, then adventure is the day's work of the field archeologist. But even so, I have found that the best adventure is an intellectual rather than a physical experience. When one encounters a ruined city in the untrodden bush there is a solemn pause and then eager action. Vines are stripped away from the sculptured faces of priests or gods. Bats are temporarily dispossessed of the mouldy sanctuaries in which they have made their homes. It is a thrilling experience to step into the past, but that is possible only if you know, or care, what the things about you mean.



GOOD TRAIL

*On bad trails there is nothing to photograph. Even here there is little more*

The sources of knowledge in Central American archeology are ruined cities as difficult of access as the sources of the Nile. To be sure, Chichen Itza can now be reached in upholstered comfort from modern Merida, thanks to a new highway that connects with the railroad. Yet only four years ago a letter written in red ink by Felipe Carrillo, shortly before that Socialist governor of Yucatan faced the firing squad, gave me the privilege of entering Chichen Itza in the first automobile. The event outlawed the picturesque *volan* of Spanish days, with high wheels and unyielding frame. The arrival of that car was desecration, if you will, but the idle curiosity of today, no less than the usefully engaged curiosity, is inexorable and is not to be stopped by reason or sentiment.

Uxmal, Labna, Kabah and Sayil now fall within the rough-riding range of a

tortured Ford. All these stone-built cities are in the populous northeastern corner of Yucatan. Like Chichen Itza they date from the Second Empire of the Mayas (960-1450 A.D.). The only First Empire ruin of easy accessibility is Quirigua, far to the south in Guatemala, which is conveniently located on a plantation of the United Fruit Company. Two full days in the saddle from Zacapa, over pine-clad ridges, bring one to the welter of monuments and temples that is called Copan. There the dates, which may be regarded as contemporary with the monuments on which they occur, range from 205 A.D. lto 540 A.D. but there are other records, possibly historical, which go back to the Sixth Century before Christ.

I give these dates because they have an important bearing on exploration. The early Mayas tamed an exuberant rain-forest area and developed enormous wealth in terms of surplus food. This was converted into a dense population as the centuries rolled by. Then came catastrophy, perhaps through the appearance of a devastating disease. The social structure broke and great cities were emptied and abandoned.

Yellow fever may have made its first appearance at this time, for there is excellent evidence that Central America was the original home of this panic-producing malady. The Mayas were forced by power beyond their control to abandon their southern holdings, which promptly reverted to the wild. They made their way into the drier and healthier parts of northern Yucatan and slowly reformed their shattered ranks.

This is the reason that explorers must go into an unpopulated and difficult country to find the finest fabrics of Mayan genius. Gorgeous and stupendous remains have been located days distant beyond the last Indian hut, and there are trackless wastes still unexplored. These may hold ruined cities larger than any modern capital in Central America.

SCULPTURE AT PALENQUE

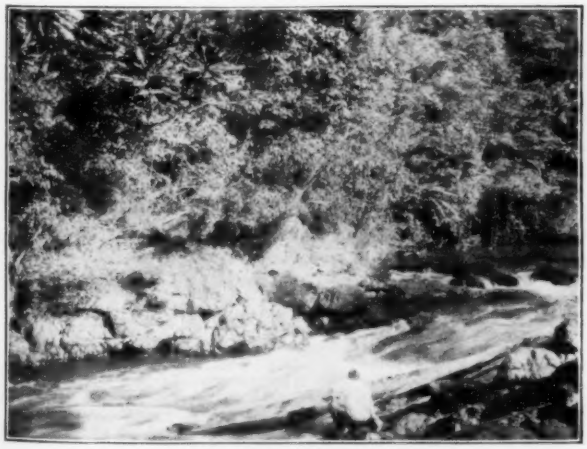
*Palenque is an old site—the first to be explored by scientists (1784)*

To set foot in such forgotten capitals as Yaxchilan, Ixkun, Tikal and Tulum —the very names are fictitious—I have tried three methods of exploration; first, overland work with a pack train; second, river work, especially along the Usumacinta and its tributaries; third, long shore work on the reef-bound eastern coast of Yucatan. Perhaps the airplane will furnish a fourth manner of archeological reconnaissance, but in this I have no ambition to engage.

For the first method, that of the slow-moving mule train with men and animals picking most of their living off the country, it is best to make as deep a penetration as possible before taking to the saddle. One convenient entrance is via Dzibalchen which can be reached by automobile from the railroad station of Hecalchakan on the line between Merida and Campeche. The mule trail leads to the Xkanha district where there are four small Indian towns on the frontier of present settlement.

To the south lies a great area of swamp and forest, unpopulated except during the rainy season and then only by bands of Indians, or vicious mixed-bloods, who tap the trees which yield the latex from which chewing gum is made. A company of these *chicleros* generally has one base camp, which may serve for five or six seasons' work, and many small camps at convenient water holes. The small camps consist of *champas*, or palm-leaf shelters. They are occupied for a few weeks only and then abandoned, although muleteers often remember their names and locations.

Crude humor is reflected in the names of the chiclero camps. Deep in the bush five days below Xkanha we came to the camp called The Other World. Other sites where we stopped were dignified by the titles, Blue Sky, New Jerusalem, Discord, and Empty Bottle. With incessant rain, life must be hard indeed in these inadequate resting places. The trails become deep streaks of mud intermeshed with roots, and the mortality in pack mules is reckoned at 20 percent for a single season's work. The archeologist makes his excursions after the rains have stopped and the chicleros have departed, but even then the footing on traveled roads is often



ROUGH, SLOW GOING

*It requires the judgment of a Hudson's Bay Indian to navigate safely some of the rapid mountain streams of Central America*

MORE UGLY WATER

*Working one's way up such turbulent streams as this, requires time and patience. The bow of a dugout canoe shows in foreground*

◄ THE BROKEN KING

*This is the stela referred to in Dr. Spinden's article. Note the curious ornaments of rope on the knees and forearms, and the battle-axe with a bone handle. This stela or monument came near being destroyed owing to the Indians' lack of appreciation of its significance to archeology*

TEMPLE AT TIKAL ►

*This interesting ruin rises high above the present forest, but the forces of Nature have already connived to bring it near to destruction. In the tropics the vegetation is difficult to strangle, and archeologists have to maintain a constant battle against its encroachment on their discoveries*

unspeakably bad—so deep is the mud.

Occasionally a camp is found on a high bank over a deep pool of clear water, offering a welcome relief from the monotony of mud and brambles. Game is always plentiful, particularly Yucatan turkeys, curassow, sundown partridges or tinamu, peccary, and small deer. Then there is a special fodder tree for the mules.

Indians make the best guides, particularly those who are good hunters or who have had wide experience in gathering chicle or spotting mahogany. They have all encountered remains in the bush and some are marvelously expert in going back over old ground. Evidences of ancient settlements in the form of mounds of cut stone are frequent enough, and in one successful season a party may discover a dozen or more ruins with well sculptured buildings more or less intact.

But there are many disappointments: one may pass within a few yards of a fine structure and not see it, so thick is the forest screen. Once I took a careful compass bearing on a high pyramid visible across a savana. Only on the third day's effort was I successful in reaching it. The line of the first day had passed within 50 feet of the mound.

A second gateway to the unpopulated central portion of the Yucatan peninsula is the British Honduras town of Cayo at the head of navigation of the Belize River. The trails fan out into Peten, a territorial department of Guatemala which contains many fine ruins, attesting a heavy population in ancient times. The "royal road" of Peten leads to the little town of Flores, picturesquely situated on an island in Lake Peten. This was the site of the last Mayan capital named Tayasal, which was visited by Cortez in 1526 and only fell before the sword and cross in 1697.

The story of mules, mozos, and machetes is a drab and dreary one unless one sees beyond discomfort. Hour after hour the cavalcade winds through a greenish twilight that rarely is pierced with a yellow stroke of sunlight. But the great temples of Tikal soar far above the tufted and flowery plain of the forest top and from such points of vantage one sees in the distance other pyramids that seem to beckon.

Then there is river work, wearisome, too, under the unshielded sun. Here

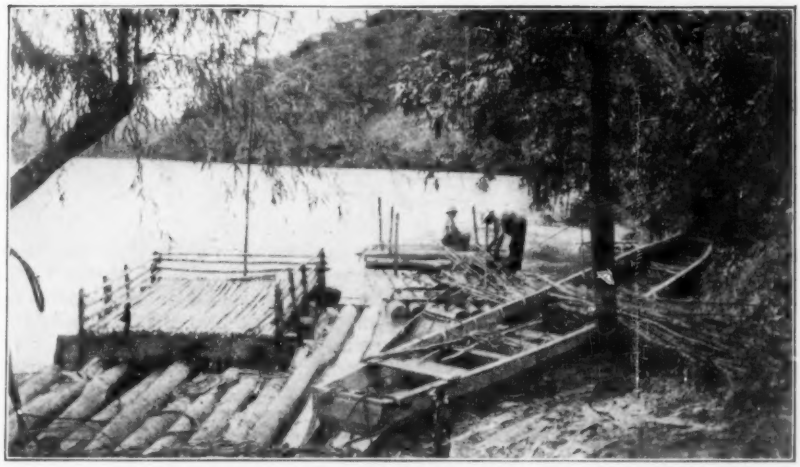
A WATCH TOWER ON THE EASTERN COAST OF YUCATAN

*The imaginative reader may amuse himself by attempting mentally to reconstruct the environs of the various Maya edifices, now surrounded by dense tropical vegetation—or by imagining future ruins of our own structures similarly surrounded by forests*

the camps are those of mahogany cutters. The Usumacinta is a stream of tremendous flow with large tributaries that issue from the cordillera and drain a dense rain forest. Here large dugout canoes, poled from dawn to dusk by patient Indians, are the principal means of transport.

There is a mud fireplace in the bow of the canoe and meals are prepared *en route*. If gravel banks are not available, camp is made on soft ground before the curtained palisade of the dense forest. In the darkness fireflies float, and the roar of night-howling monkeys is seldom wanting.

Along the Usumacinta several large and important ruins, discovered at the close of the last century, may be said to rise from the water's edge. Others, farther back, will doubtless be revealed by future searching parties.



BUILDING RAFTS FOR DESCENT OF THE WANKS RIVER

*The logs are of balsa. Even when freshly cut, balsa is much lighter than cork. Balsa is now being imported into America for life-rafts and heat insulation in refrigerators*

DISCOVERY may come suddenly enough. Once at a new clearing I climbed the bank to ask about ruins, and found three men waiting for the meal that a buxom negress was preparing. No, none of them had heard of ruined buildings or of stones with carvings.

Then the cook spoke up: "But the Broken King—perhaps he wants to see the Broken King." This turned out to be a limestone stela of the best period of Mayan art. It was buried under a huge slashing already dry enough for the torch, and had we arrived a few days later the beautiful sculpture would have been calcined hopelessly by the flames. We made drawings and photographs of this monument which represents a warrior with gorgeous head-dress of pendant feathers. He carries a battle axe with leg-bone handle. The inscription says that several events happened between May 3, 527 and September 16, 531. Whatever they were, the king, now broken, seems to have come off victorious.

In 1925 I took part in an expedition along the east coast of Yucatan with a 65-foot schooner for a floating base. This coast had only recently been rendered safe for landing parties by the pacification of Indians who had rebelled in 1848. Eastern Yucatan is dangerously beset with coral reefs behind which are wide shallow bays fringed with mangroves. Occasional gaps in the reefs give passage-way for boats of shallow draft when skillfully manipulated. To reach the shores we had skiffs with out-board motors and were successful in locating several important ruins at short distances back from the coast. These remains belonged to the last stage of Mayan history, and some of them were doubtless inhabited towns when the Spaniards appeared out of the dawn in 1517.

A BUILDING AT SANTA ROSAURA, YUCATAN

*In the tropics, even to a greater degree than in the north, the roots of trees pry the ancient masonry to pieces, reducing it to ruin. Doubtless they hide many an undiscovered edifice*

Collateral explorations outside the territory actually occupied by the Mayas is necessary to show the effects of their civilization upon surrounding peoples. For several seasons I have made field studies in eastern Honduras and Nicaragua, and so on, with this end in view. On one occasion I passed down the Wanks River which heads not far from the Pacific and enters the sea at Cape Gracias a Dios. The first part of the journey was by rafts; then, after a visit to the villages of the Sumo Indians on the Bocay River, I had five days more in pitpans before reaching the head of steamboat navigation. A band of pirates made the same voyage in 1688 because the Spaniards had burned the ships at Amapala.

THERE are no ruined cities in this southern territory but there are remains of palisaded towns. Also there are ceremonial deposits of stone bowls and especially of corn-grinding implements. I reached one such deposit five days up the Plantain River above the uppermost Paya village. Such an expedition has its best justification in search for facts, rather than in search for adventure. Yet one may experience a wholesome revaluation of human capabilities after observing how so-called primitive people meet the exigencies of their life.

It is the beyond that always lures the explorer, but this is primarily an intellectual lure. I have not noticed that the thrill of discovery is any less in the laboratory than in the most romantic surroundings. Look at it in this way: a mechanism of dials, batteries and strung wires will bring the roar of Broadway to the still Courts of Tikal, but there is no mechanism except the carefully sensitized mind that can make the past of America speak to the present.

# Our Point

### OUR READERS MAY LOOK FORWARD

IT is with mingled regret and anticipation that we announce a break in our local editorial family. After over thirty years of appreciated effort in these offices, Mr. J. Bernard Walker, our Editor Emeritus, is taking a well-earned sabbatical leave of absence and is at present on his way on a sort of roving, piecemeal journey around the world. Free to go wherever he pleases and to change his itinerary on the instant, he will send from whatever part of the world his fancy chooses, the same kind of interesting technical discussions he has so long provided you with. We may therefore look forward to the publication from time to time of Mr. Walker's welcome contributions.

### FOR YOUR SAFETY

THE traveling public should be made acquainted with the excellent work which is being done under the order of the Interstate Commerce Commission, requiring certain of our most important and congested railroads to install the automatic stop. Ever since the order was made, and indeed, in some cases for several years before that, the railroads had been carrying out elaborate and costly experiments in the endeavor to find a weather-proof stop that would also be foolproof. The railroad engineer has never run up against a more puzzling and difficult problem than this; but, with the aid of the various inventors of the country, the problem has been solved.

Under two orders of the Interstate Commerce Commission the railroads are required to equip a total of 8399.6 road miles and 6983 locomotives with train-stop or train-control devices complying with the specifications and the requirements of the commission. On September 1, 1927, 7487.8 road miles had been equipped, or 89.1 percent of the requirement. On the same date 6167 locomotives, or 83.3 percent had been equipped.

It should be understood that "road miles" means miles of road or roadbed protected, regardless of whether the roadbed carries single-track, double-track, three-track or four-track line. The miles of track actually protected by September 1, 1927, exceeded 13,000 miles. The statement of mere mileage, however, does not convey an adequate impression of the protection afforded; for the stretches of line selected by the commission were those on certain first-class railroads, upon which the traffic is most dense and complicated. We have 250,000 miles of railroads in this country, it is true; but we must remember that this form of train protection is practically a new art and calls for the expenditure of much time, capital, and experimental work in producing a thoroughly reliable system.

### SCIENTIFIC TRUTHS ABOUT SEX

HOW far in this age of frankness can a journal such as the SCIENTIFIC AMERICAN go in the discussion of sex?

#### They Will Bear Watching

IT is becoming eminently apparent that the magic word "ultra-violet" is destined soon to be exploited as the basis of another series of deceptions of the public—the same public which has already suffered from the over-enthusiasm of treatment cults without end. The subject of ultra-violet rays, as more recently set before the general public, may now be said to be in the early "gold rush" stage of its development. All sorts of ridiculous claims are being made in the name of the vital ray, by people who do not know what they are talking about. And because of this, a previously well-tried, well-recognized method of treatment—that is, treatment with the sun's rays and with lamps which give out similar rays—is in imminent danger of acquiring a bad name with the public because of the inevitable linkage with the not-genuine.

Let us repeat this: treatment with ultra-violet radiation has long since proved its worth but some of the recent developments come pretty close to pseudo-science and will bear watching. Elsewhere on these pages we publish further comment on the same subject.

The editors are quite well aware that what they write is certain to be read not merely by adults but by young people. Technical refuge, at least, might here be taken in the truthful claim that this is a scientific journal, and that matters of sex are truly matters of science which may therefore be discussed here. But we prefer instead to take umbrage under the fact, that there is not much use, anyway, in making believe that our youth will find this a wholly virgin field of thought. As everybody knows nowadays, it is a long time since this has been the case. So we shall be doing no harm and much good by being frank. Moreover, we think that except when judged by the rather hypocritical standards of other days, the youth of 1928 are a better lot than the youth of 1898 and can stand frankness.

We recall that in our time some of the youth obtained their information about sex from their parents. But most of us received it from older youths; also from bums and from nice old "fuddyduddys" who wrote mawkish books about "what a youth should know"—books which in some way implanted in our young minds the falsehood that sex was bad.

We therefore make no apology for mentioning here a series of pamphlets which we sincerely believe the majority of our readers should see and know about—the recent publications of the National Committee for Mental Hygiene, prepared by the well-known sociologist, Katherine B. Davis.

These several pamphlets, which we are advised are available for distribution to serious readers, will inevitably irritate many, for the truth always irritates. They will shock a few of the tender-minded, and they will doubtless confound utterly some of the misbeliefs even of the scientifically minded.

What *are* the "average" sex practices of the human race? We have thought we knew, yet it appears we did not know. We have often mistaken "general impressions" and traditions for fact. We have obtained most of our knowledge from hearsay and we have had it wrong. What we have been living and thinking under amounts to a sort of conspiracy on the part of a whole race to deceive that race concerning itself. And it is a fact that science still knows more about the sex life of the other animals than is known about human sex life.

We said above that the new revelations will irritate and shock many who are not psychiatrists. Some will jump to the conclusion that the whole race has suddenly gone to the dogs. Has it? Hardly that. We are simply finding out at this late date what has always existed—and no matter how the new evidence be interpreted, the human species seems to have got along pretty well, and for a long, long time at that. It must be, then, that

# of View

our reasoning is faulty. We must therefore liquidate our present beliefs and remold them on a more exact, scientific basis. In short, if what we have thought to be abnormal in sex life now turns out to have been more the rule, must we not now revise the very criterion of what actually constitutes average normal sex life?

Now that humanity is coming of age it is time it stopped deceiving itself.

### A BALANCED NAVY

IT gives us much pleasure to state that there is now every prospect that the present Congress, with the President's approval, will set about the too-long-delayed work of putting our navy in proper balance. For many years, since 1904 in fact, we had realized with much concern that the General Board of the navy was building up our battleship fleet at the expense of the lighter, faster and less heavily armed and armored classes of ships. Always we have been short of cruisers, and before the World War we were short also of destroyers and submarines.

If the present recommendations of the General Board are put through—and we believe they will be—our shortage in the lighter ships will be made good under a building program which will extend over a series of years. This will bring us up to parity with Great Britain in cruisers, as we now have parity in battleships. The country is in the mood to sanction this work. It should be the earnest and continued effort of the friends of the navy to see that, year by year, Congress votes the necessary funds to carry out this program.

If the above is propaganda, so be it; for it is helpful and honest propaganda of the kind that the files of the SCIENTIFIC AMERICAN will show to have been carried on by us for years past.

### MORE REVELATIONS ABOUT ULTRA-VIOLET RAYS

FABRICS are now on the market which are advertised to let through to the wearer's skin the vital, health-giving ultra-violet rays of the sun. As is the case with most of the new kinds of glass for the same purpose there has been a considerable amount of first-class bunk in the sales methods employed. Some of the salesmen either do not know their science—or, if they do.....!

The United States Bureau of Standards has recently been testing some of these special fabrics. It finds that the threads themselves transmit 5 to 10 percent of the vital, short-wave fraction of the sun's ultra-violet. Some of the fabrics transmit more because they are "open weave;" but so would any other open-weave fabric. "To obtain beneficial therapeutic results," says the Bureau, "an open-weave fabric should be worn. Admitting this fact," it continues, "it is apparent that it makes but little difference whether the thread is of cellulose, cotton, wool or silk. It seems evident that the importance of the composition of the material has been over-estimated."

At the most advantageous season of the year for such an experiment the writer of the present comment made a direct test of cellulose acetate, sold under a trade name, and found that it did let through enough ultra-violet to cause a certain tan, provided open-weave (voile) samples were used; but samples of wash satin ten years old transmitted a better tan than the close-woven fabrics made of cellulose acetate. Viscose, which sells under a trade name known to every woman and most men, was also among the fabrics tested by the Bureau of Standards and it is included within the meaning of these comments.

One point which apparently has been overlooked by prospective purchasers of fabric and glass for transmitting vital rays, and by some of the salesmen as well, is that no more ultra-violet radiation can be transmitted by any material than is available. This should be self-evident. And in winter, just when most of us need the ultra-violet radiation most, the vital rays are scarce, rare or virtually absent from the natural sunlight, depending on the time of day, altitude of the sun and the impurity content of the atmosphere. The quantitative values reach only a fraction of those for the Summer sun at a corresponding time of day. In the big cities of the north the alleged beneficial effect of the mid-winter ultra-violet is chiefly psychological.

In a short time the public is due to become "educated" about the physics of ultra-violet radiation, and then certain of the present sales methods employed in connection with it will have to be revised upward.

### FORTY-KNOT LINERS

EVERY now and again our old friend, the 40-knot transatlantic liner, steams majestically, if mythically, across the page of your morning daily paper. You are told that such and such a company is about to build a ship bigger than any other and capable of doing 40 knots on the high seas—blow high, blow low. We confess to a little editorial weariness in puncturing this perennial bubble; but in justice to our readers, and especially the younger people among them, we have to say once more that the 40-knot liner is, to use a classical phrase, just a mere "pipe dream." Such a liner would have to be at least as big as our airplane carrier *Saratoga*, whose engines of 180,000 horsepower are the greatest afloat. They drive her at 33 knots. The increase in horsepower above that will be at least as the cube, and possibly as the fourth power, of the speed. At 37 knots the ship would require 300,000 horsepower; at 39 knots 450,000 horsepower; and at 40 knots you would have to cram machinery of 500,000 horsepower within her hull. Query: Where would you put the passengers and who would foot the bill?

### Army Flood-Control Plan

AS we go to press, President Coolidge has submitted to Congress the army plan for controlling the Mississippi. It proves to be not so ambitious as that which calls for the raising and strengthening of the levees sufficiently to keep within bounds a flood larger than that of 1927. The plan proposed in the army report would cost about 300,000,000 dollars as against 500,000,000,000 dollars; but it would not attempt entirely to restrain the waters of a flood larger than that of last year. It contemplates a moderate raising of the levees, the building of new levees further back from the river where a "bottle-neck" occurs, and the provision of "floodways" to operate only when the floods exceed a certain height. Furthermore, it is proposed to provide a "river-bank floodway" from Cairo, Illinois, to New Madrid, Missouri. The plan is economical to the extent of saving probably some 200,000,000 dollars; but the economy is gained at the expense of the large areas which will be put under water when they serve as floodways.

REEF ON SOUTH SHORE OF VANCOUVER ISLAND, COVERED WITH BROWN SEAWEEDS (POSTELSIA)

# Our Richest Source of Vitamins

## *Down to the Sea For Seaweed May be the Next Step in Replacing Our Disappearing Sources of Food Supplies*

By JOSEPHINE E. TILDEN
*Professor of Botany, University of Minnesota*

AT least in one respect man today is no different from his caveman ancestor: his main object in life is the obtaining of food. It is the food that is different.

In early times man used raw food, as many other animals still do. The writer remembers watching with horror, during her first visit to a certain tropical island, an old native eating a live fish which he had caught in his net. He took bites from it as casually as if he were eating a banana. Before fire was discovered, food must have been taken in its natural state. The smaller sea animals were eaten alive. The flesh of larger animals was consumed as soon as possible after the hunt was over. Nutritious roots were dug up and cleaned and feasted upon wherever encountered. Green leaves and seaweeds were chewed and swallowed while still crisp and fresh. Fruits were enjoyed as they were plucked from the tree. There was no dearth of vitamins in such food, for it consisted in the main of living protoplasm.

The food of civilized man consists of the same materials as were used by his remote ancestors: the flesh of animals and the edible parts of plants —roots, stems, leaves, and fruits. The resemblance goes no further. The treatment of this food before it reaches the stomach of hungry man baffles description. It is ground, sifted, shredded, mixed, dried, tinned, boiled, baked, stewed, fried, steamed, fermented, pasteurized, sterilized; it is covered with sauces, dressings and condiments; and it is even colored and beautified in a variety of ways. The main point of difference is this: *the protoplasm has been killed; the vitamins have been destroyed*—for the most part by the application of heat.

Physicians and biologists know, and the public is beginning to realize, that the important problem at this time is not only to discover means of obtaining more food, but to find out what is the matter with the food we have. Every newspaper reader is aware that the "deficiency diseases," so alarmingly prevalent, are caused by a "lack of something" in the food used by the afflicted persons or animals.

WHAT is to be done? Apparently, the logical thing to do is to discover the nature of the missing food-factors, in what substances they naturally reside, how these substances may be prepared for use as food without an accompanying loss of the necessary factors, and how quantities of such nutritive material may be obtained and widely distributed to the people.

An examination of conditions in the animal kingdom may give a clue. Nature has provided certain food for young animal organisms: thus, the first source of nutriment for the growing bird embryo is the yolk of the egg; the first food of the mammalian infant is milk. Soon, however, the young herbivorous animal is consuming tender green plants, while the parents of the young carnivore are providing him with the body-fat of animals.

It is now known that eggs, fresh milk, green plants, and animal flesh contain more than proteins, carbohydrates, fats, and inorganic salts—the four great classes of foodstuffs. The bio-chemist has proved beyond a doubt that several kinds of food-factors now termed "vitamins," are present in egg yolk, milk, and in most fresh plant and animal tissues. He has also proved that such vitamins must be present in the food of civilized people and in the food of animals under the control of civilized people, or such deficiency diseases as tooth-decay, rickets, neuritis, scurvy and goiter, will continue to afflict human beings; and alkali disease, softening of the bones, goiter, rickets, hairlessness, paralysis, bone and joint disease, malnutrition, leg weakness, roup, stiff neck, beriberi, black tongue, and others, will increase and spread among domestic animals. Again, other necessary food-factors are iodin and iron; the former as a preventive of goiter and other thyroid troubles, the latter as an aid in the passage of oxygen through the blood.

The bio-chemist can not as yet explain what vitamins are, for they have

not been completely separated; but, from innumerable tests made by investigators in various fields, the occurrence, and finally the origin, of these invisible food-factors, have been discovered.

Vitamin A appears to be present only in foods containing fatty material. It occurs in the green parts of land plants and in marine algae, or seaweeds. Indeed, plants are the only organisms capable of manufacturing vitamins, but animals acquire them by means of eating the plants. Thus, vitamin A is found in butter, cream, cheese, mutton and beef fat, when the animals producing these foods have been fed upon fresh plants. It is extremely abundant in cod-liver oil. For a very long time it has been known that cod-liver oil is a cure for the disease called "rickets," but no one could explain the reason why until about a dozen years ago when vitamins were discovered. Vitamin A is essential for the healthy growth of the entire body and for the proper development of the teeth. Rickets and caries, or decay of the teeth, are caused by continually eating food in which it is not present.

SORTING LAVER

*Laver is one of the many edible species of seaweed that are widely popular in Japan*

Vitamin B is contained in the seeds of plants, as the wheat germ, and in the eggs of animals. Its absence from food is the cause of neuritis and beriberi, diseases characterized by inflammation of the nerves.

Vitamin C occurs in richest amount in the orange, grapefruit, and lemon, but is present in lesser degree in the juices of many fruits and vegetables. Its absence causes scurvy, a disease characterized by ulcerated gums, falling teeth, sores, and dropsy.

It is interesting here to recall the fact that Captain James Cook made a thorough study of scurvy and its prevention and cure during his three voyages from 1768 to 1779. In his treatment of the disease he was marvelously successful. The most important anti-scorbutics used on the *Endeavour* were: sauerkraut, mustard, whole wheat, inspissated orange and lemon juice, saloop (a decoction made from the roots of common meadow plants), portable soup, sugar, molasses, vegetables ("at all times when they could possibly be got"), malt, and raisins. Not only was Captain Cook elected a Fellow of the Royal Society, but he was given the Copley gold medal for the best experimental paper of the year, on the means he had used for the prevention and cure of scurvy.

VITAMIN D is abundant in cod-liver oil. It has the property of preventing rickets by causing normal bone growth.

Cod-liver oil has been proved to contain all four of the vitamins, A, B, C, and D. Its therapeutic value is now attributed to its vitamin and iodin content.

So much for the occurrence of vitamins. It is more difficult to account for their source. However, the origin of vitamin A, in fish oils and fish-liver oils, has been traced back by the biochemist to the synthetic powers of marine algae. This point makes it necessary to delve deeper into fundamental principles.

A study of the plants and animals of the sea, their structures and functions, and their inter-relationships, will bring to light certain facts in nature that are every whit as interesting as the sensational statements of the nature-faking writer.

Illustrations on this page from Bulletin of Bureau of Fisheries

KELP FISHERMEN OF HOKKAIDO

*Long poles with knives or hooks on the end are used to separate the kelp from the rocks, and bring it up to the surface where it is gathered*

In the first place it should be thoroughly realized that green plants (those containing chlorophyll), including all marine algae, are the only organisms that are able to manufacture food. In the presence of sunlight as a source of energy, the seaweed constructs food from inorganic materials, such as carbonic acid and other ultimate food-stuffs from the sea-water surrounding it. In some unknown way it makes over these simple substances into complex chemical compounds, such as proteins, carbohydrates, fats and inorganic salts, and powerful chemical energy is concentrated. The plant is a producer. Marine algae, then, are responsible for all the food produced in the ocean.

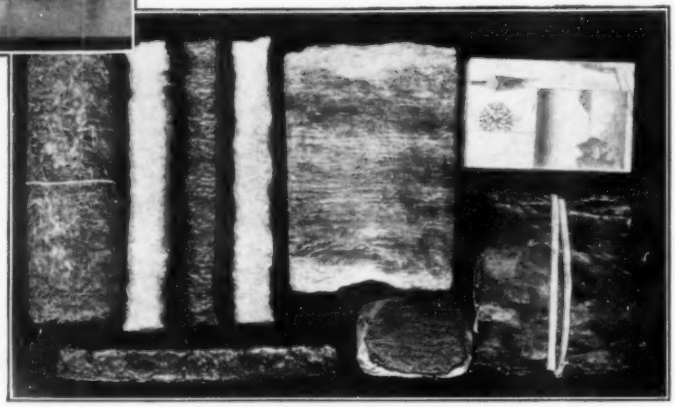
PREPARING LAVER

*The weed is cut and dried and then prepared in sheets for the market, as shown above*

On the other hand, animals can not make food. They merely consume, directly or indirectly, the food constructed by plants. It has been truly said that the animal is not a producer. It can not produce substance. It can not produce energy. It is a transformer. Animals, including man, require food in the form of carbohydrates, proteins, fats and minerals salts, and this is exactly what is provided by the plant. The marine animal in eating the seaweed, transforms the "powerful concentrated chemical energy" stored up in the tissues, sets it free, and uses it for its own development. Marine animals, then, necessarily depend upon seaweeds for their existence.

A second fact is of great importance in the consideration of food. Green plants, again, are the only organisms that can manufacture vitamins. Marine algae, in connection with their photosynthetic activities, elaborate all four of the important vitamins, but are especially rich in vitamin A. Animals are not able to make vitamins. The relatively small amounts of vitamin substances which animal flesh contains, are derived from their vegetable food.

The third fact to be noted is that marine algae have the power of absorbing iodin from the sea water. They



JAPANESE FOOD FROM THE SEA

*The upper illustration shows Miss Woo eating* hai tai, *a common algal food used in China, and imported from Japan. The lower photograph is of several bundles of marine algae purchased by the author in Japan*

store it in considerable amount in their tissues. The large, coarse, brown "kelps," in particular, are very rich in this element. Animals are not able to extract iodin directly from the sea water, but many of them come to contain it in small amount from eating marine plants.

It is then true that marine animals obtain all of their food, and with it, all of their necessary supplies of vitamins and iodin, from marine algae or seaweeds. This explains why animal sea-food is so much richer in vitamins and iodin than the flesh of land animals. The latter depend ultimately for food upon land plants which, in turn, are not always able to secure the proper kinds of raw materials for their food in the soil in which they grow. As an example, the soils of the so-called "goitrous regions" are lacking in iodin. On the other hand, in the ocean all the necessary raw food materials are constantly at hand. Thirty-two of the elements are known to exist in seawater, including all those used by plants.

To recapitulate, cod-liver oil contains iodin and all four of the necessary vitamins. While it must be placed far ahead of all other available food substances, it must be remembered that all sea-foods are rich in this respect, and should be included in the diet of civilized man.

SINCE marine algae are even richer in these food-factors than are marine animals, they too should be added to our food. Powdered seaweeds when mixed in small amounts with other food can not be tasted. In larger amounts they impart a pleasing taste and are much relished by persons accustomed to their use.

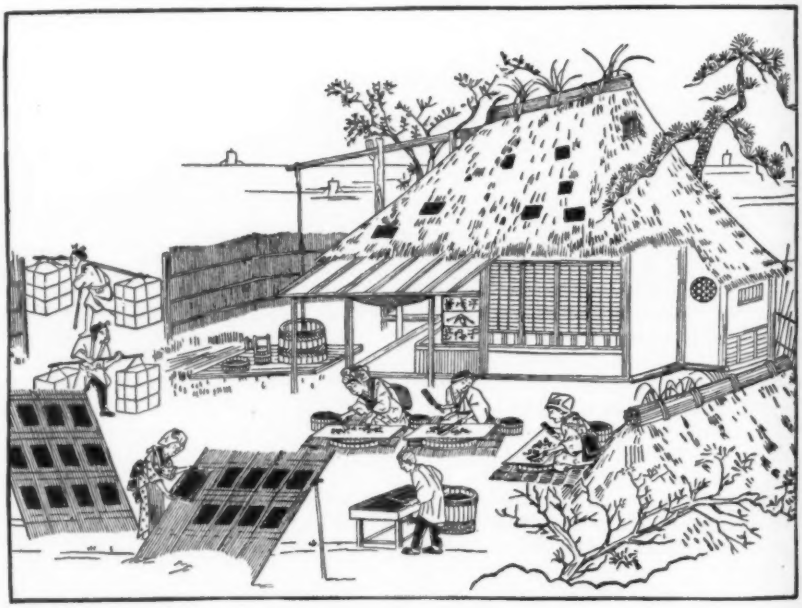
Since time immemorial marine algae have formed a very important part of the food of the Japanese people. At the present time perhaps six or seven different kinds of seaweeds are used at a single meal. Goiter is unknown in Japan. Without doubt the hitherto almost national diet in Japan, consisting of rice, fish, and seaweed, has had much to do with the good health, the high degree of general intelligence, and the unusual artistic, literary, and scientific attainments of this race. Among the Chinese people the same thing is true. In the "extraordinary physical capacity and endurance of her people there is the physical basis of the isuccess throughout the ages."

The writer had the good fortune to live for a time in Tahiti while the natives were still existing under the effects of a diet consisting largely of seafoods, vegetables and fruits. The people were vigorous in body and mind, handsome and healthy, and their teeth were perfect. Later, pastry shops and ice-cream wagons were introduced into this paradise and the bad effects upon the teeth were very soon apparent. Tahitian children today have soft, crumbling, and badly decayed teeth.

The results indicated in the following experiment are startling when one considers what may be their bearing on the future of our race. This experiment proves that neither the kind of food nor the softness of the food is to be blamed as the cause of defective teeth. Normal development and growth of the first teeth in infants depends upon the presence of the growth-factor, vitamin A.

A puppy was fed from birth on food deficient in this factor. It developed extremely poor teeth. A second puppy was fed on a diet containing butter. The results were more satisfactory; but at the end of six months some milk teeth still remained in the jaw; not all of the permanent teeth had erupted, and the enamel was slightly defective. A third puppy was brought up on a diet containing cod-liver oil. At the termination of the experiment—about six months—all the milk teeth were changed. The permanent teeth developed in perfect condition.

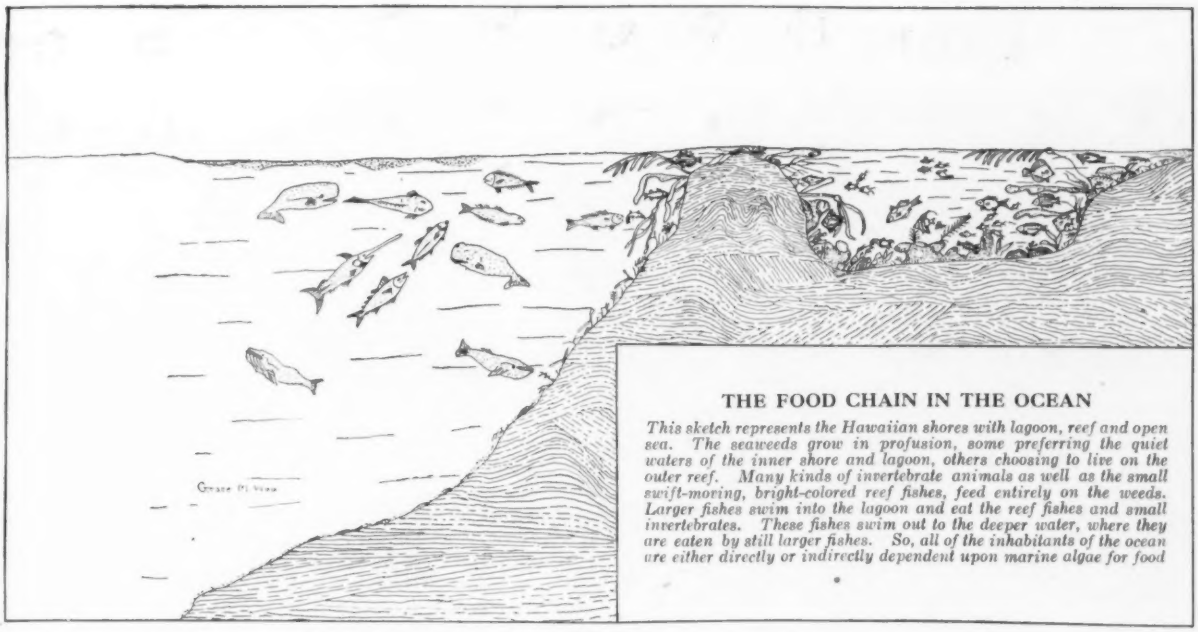
All fat marine fishes contain the necessary food-factors, so that not only is cod-liver oil a wonderfully



From Bulletin of Bureau of Fisheries

THE PREPARATION OF *PORPHYRA*

*An entire Japanese family engaged in preparing different kinds of seaweed for market*



THE FOOD CHAIN IN THE OCEAN

*This sketch represents the Hawaiian shores with lagoon, reef and open sea. The seaweeds grow in profusion, some preferring the quiet waters of the inner shore and lagoon, others choosing to live on the outer reef. Many kinds of invertebrate animals as well as the small swift-moving, bright-colored reef fishes, feed entirely on the weeds. Larger fishes swim into the lagoon and eat the reef fishes and small invertebrates. These fishes swim out to the deeper water, where they are eaten by still larger fishes. So, all of the inhabitants of the ocean are either directly or indirectly dependent upon marine algae for food*

curative remedy for deficiency diseases, but all animal seafood—especially fish, oysters, shrimps, lobsters, and crabs—contains valuable protein and fat, and at the same time it is richer in vitamins than the flesh of land animals and fresh-water fish, and a far better source of iodin. It may be stated with absolute truth that marine food is the best food known at the present time. If cooked properly it is found that the food factors are not destroyed—except in the case of vitamin C, which may be obtained from fresh citrous and other fruits, and green vegetables.

No single food substance known

BROWN ALGA

*This seaweed is very popular with some fish. It bears tiny fruit, and it seems that the fish deliberately pick these off, just as we are wont to pick apples from the trees*

contains such a high amount of iodin as certain marine algae. Tressler and Wells report that dried Atlantic seaweed was found to contain 900,000 parts per billion of iodin. Marine invertebrates and fishes feed upon these plants, or upon other animals which have eaten them, and thus the flesh of all will contain a certain amount of iodin.

The codfish is not herbivorous. It eats certain small crustaceans, which in turn feed upon seaweed. In this roundabout way it obtains the vitamins and iodin that are stored in its liver in such abundance. It is the liver of the animal which seems concerned in this storage process. The liver-oils of all fishes and other marine animals are extremely rich in these special food-factors.

HOW the various kinds of seafoods may be secured in great quantity and how they may be widely distributed to the people needing them, are questions of great magnitude. While Dr. East points out that the world is fast reaching the end of its land reserve, he takes a discouraging view of the possibility of making use of the food resources of the sea to any great extent, because, as he says sadly, "The truth is that proper data do not exist by which to estimate accurately the stock in Father Neptune's larder."

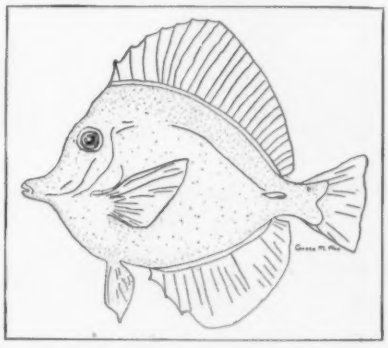
Dr. East is perfectly correct in his assertion that such statistics are not available. Not even a beginning has been made in the procuring of materials which would make such an inventory possible. A long and patient study, on a co-operative plan, of all existing "food-chains" in the ocean, is our only hope of conserving the rich materials in Father Neptune's larder.

There is a good opportunity here for trained workers in the algae and in marine zoology. The life history of all species of marine algae must be carefully worked out; their structures must be studied and their tissues observed and illustrated, so that when minute portions are found in the digestive tracts of animals, they may be recognized and tabulated. Likewise, the life histories of marine animals must be followed out; the digestive organs in particular being given thorough study. The bio-chemist must discover the effects of the digestive juices of the animal upon the plant tissues ingested, and the effects of the plant food upon the animal consumer.

The Chinese have a proverb which represents popular opinion today with regard to life in the sea:

"Big fish eat little fish;
Little fish eat shrimp;
Shrimp eat mud."

There is no questioning the truth

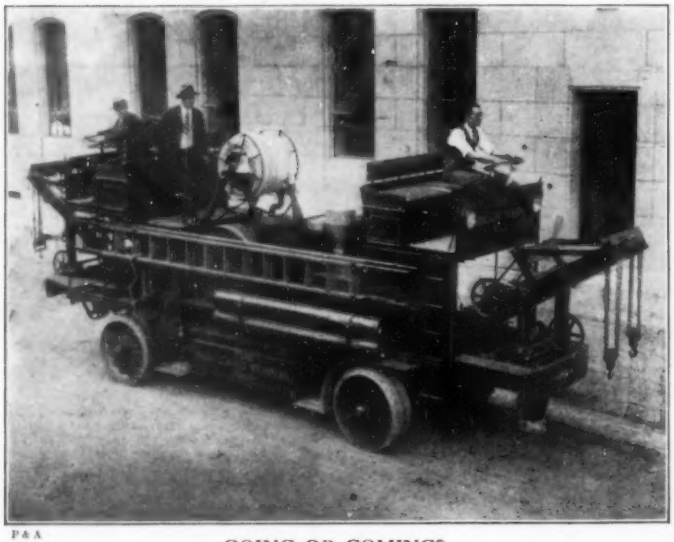


HAWAIIAN REEF FISH

*This beautiful little chrome-yellow denizen of Hawaiian waters, known as the "surgeon fish" (Zebrasoma flavescens) seems to exist and thrive entirely upon a diet of seaweeds*

of the first statement and the second is approximately correct; but the third involves an entirely new problem and one of vast possibilities. The great need at present is an extended, co-operative scientific investigation of the "mud,"—in other words, seaweed food—said to be consumed by the shrimp.

# From the Scrap-book of Science—



P & A

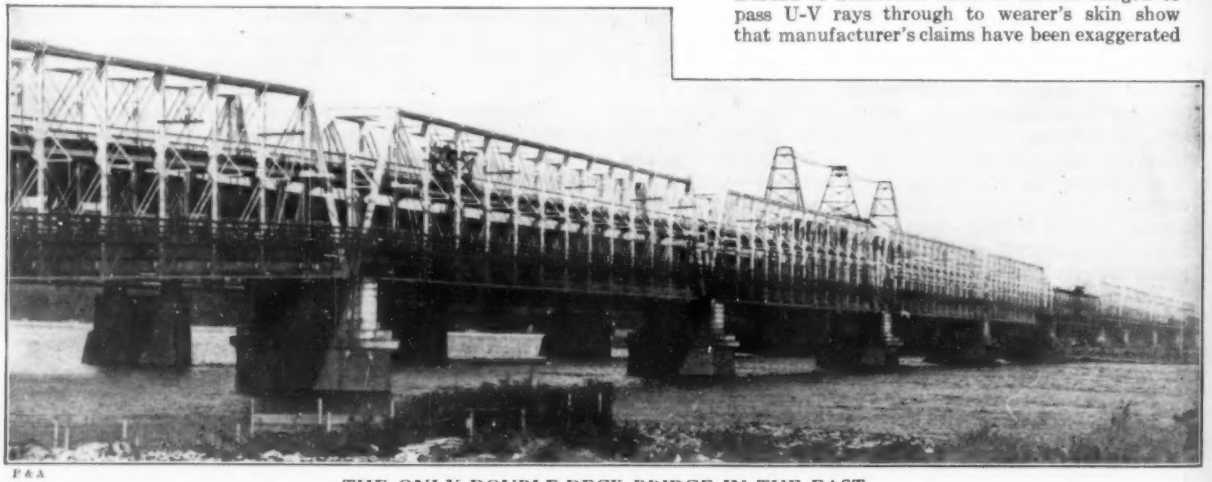
**GOING OR COMING?**

The new Holland tunnel under the Hudson River for motor vehicles, connecting Manhattan Island with New Jersey, has a combined fire truck and wrecking car which is equipped to be driven at either end

P & A

**ULTRA-VIOLET RAYS**

Bureau of Standards tests on fabrics alleged to pass U-V rays through to wearer's skin show that manufacturer's claims have been exaggerated



P & A

**THE ONLY DOUBLE-DECK BRIDGE IN THE EAST**

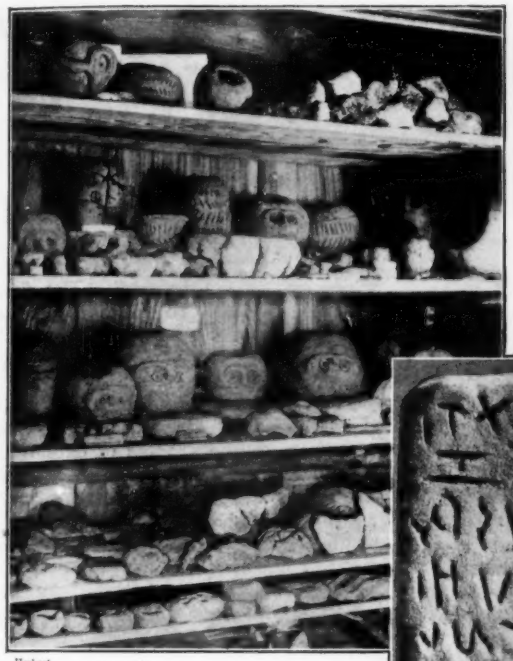
The Susquehanna River Bridge at Havre de Grace, Maryland, is being double-decked, and north-bound traffic will use the top while the south traffic will follow the present bridge flooring. The special work will cost about 250,000 dollars

Underwood and Underwood

**SPECTOGRAPH**

The curved rack is a film support for a large concave-grating spectograph used at the Bureau of Standards in Washington. At left is the concave diffraction grating itself, the "business end" of the apparatus. On each inch of this metal grating's width many thousands of minute parallel lines have been ruled. The grating produces a widely dispersed spectrum, parts of which are then photographed on film for study and record

# Camera Shots of Scientific Events



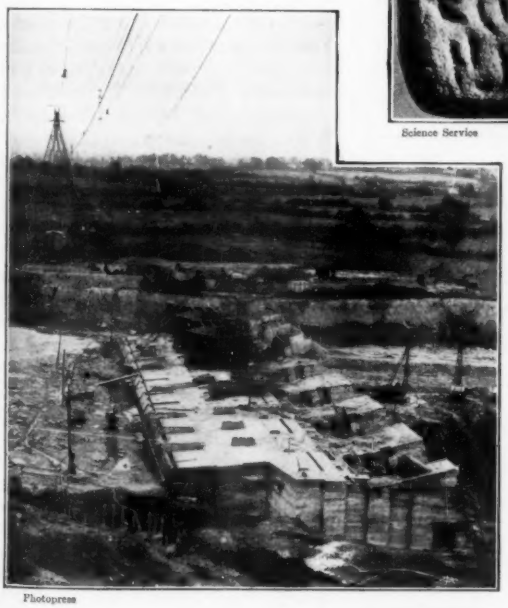
Herbert

Herbert

Science Service

### FACT OR FAKE?

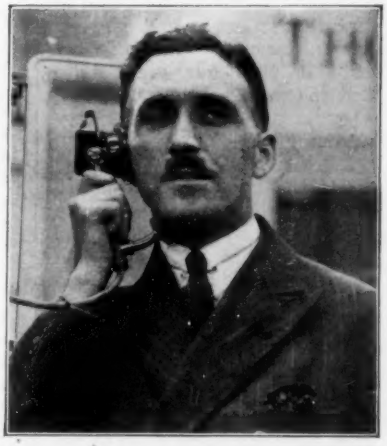
Four years ago at the little French village of Glozel, a peasant plowed up some buried objects. Although pronounced fakes by the foremost authorities, the finds received increasing attention until recently, when a committee of anthropologists went to Glozel to unearth more of these "Glozelian" artifacts. As we go to press no decision has been rendered, but the French people and scientists all over the world have followed the development with keen interest; because, if the finder's claims are true, the many tablets discovered (see picture at left) indicate that our alphabet did not originate with the Phoenicians as has long been believed, but many thousands of years before and in Europe



Photopress

### ◄ RIVER SHANNON

Ireland is modernizing. A wier is being constructed where the River Shannon flows. Later, hydro-electric power will flow to Irish homes and factories, bringing cheer and wealth

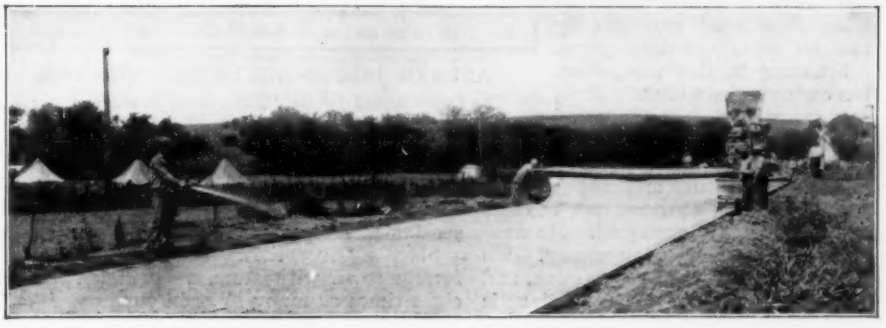


### "DIN-O-PHONE" ►

In factories and places where the din affects 'phone conversation, telephones having transmitters in direct touch with the neck, may be used. Outside sounds are thus excluded

### A CLEVER PLAN FOR HANDLING BURLAP ON PAVING JOBS ►

A new plan for handling burlap on paving jobs has been developed by a paving corporation in Omaha. Strips of burlap sewed together in 100 foot sections, rolled on pipes, are carried on a rolling bridge which clearly shows in the picture. Thus the burlap which protects concrete against drying out may be rolled up like a curtain for easy transportation



# Has the Universe a Limit?

## *It Is Easy to Prove That the Stars Are Not Infinite in Number, and That the Universe Is Finite. How Large, Then, Is It?*

By HENRY NORRIS RUSSELL, Ph. D.

*Chairman of the Department of Astronomy and Director of the Observatory at Princeton University*
*Research Associate of the Mt. Wilson Observatory of the Carnegie Institution of Washington*

HAS the Universe a limit? This is a complicated question to answer, in more ways than one. To begin with, it is not merely one question, but many. For the word "universe" is one of those which are used with two or three different meanings—as somehow it appears to be the genius of us English-speaking people to do.

If the philospher's significance for the word is taken—which includes within it all that may exist anywhere in realms of matter or spirit—we may well leave to the metaphysician the task of answering.

The mathematical physicist employs the word in a narrow sense to describe that manifold of space and time with which the theory of relativity deals. Everyone knows now, by hearsay at least, that it is mathematically conceivable that this universe may be finite but unbounded (just as the surface of a sphere obviously is). It is not impossible, either, that if it is finite, human science may be able to measure its dimensions, but all that can now be said is that these must be so great that the distance of the faintest nebulae that our great telescopes can reveal must be but a very small part of the way "around" it.

THE astronomer is prone to use the word in a still more limited sense to denote the great assemblage of stars which forms the Milky Way. This usage does some violence to etymology, for to talk of "other universes," "island universes" or the like is really to mix metaphors rather badly; but it is well established and it really does no more harm than to retain the word "above" for something that most emphatically can be separated into parts.

Speaking in this wise, then, has *our* universe a limit? If so, how can we detect the fact and find its dimensions? Before the distance of even a single star had been measured a century and more ago, Sir John Herschel discovered how the first question might be answered. No elaborate observations are necessary. We need only one fact of observation, and this the simple one that the night is dark. And the reasoning involved is simplicity itself.

Suppose that our universe is unbounded; that space in all directions from the sun is sown with stars as thickly (or thinly) as it is in its nearer parts, and to an infinite distance. Now consider all the stars up to any given apparent brightness—say those brighter than the sixth magnitude and therefore just visible to the naked eye. Some of these are brighter than others, in reality, and they will be at different distances from us. But all will be confined within some limited region of space.

Let us now extend our count to all the stars which appear to us to be more than one quarter as bright as our first limit (which will take us down to the magnitude of 7.5). Since the apparent brightness of a star varies inversely as the square of its distance, we will now be able to see stars of any given degree of real brightness twice as far away as before—which means that we will see all that lie in a region of space twice as long and broad and high, or of eight times the volume, in which we were seeking at first.

Since by hypothesis, space is uniformly sown with stars, we will get eight times as many stars in our new list as in our old one, and although they average to our eyes only a quarter as bright, all told they will send us twice as much light as the group with which we began to deal. The first set will be visible to the unaided eye and most of the second will not, but the greater number more than makes up for their faintness.

All this sounds safe and sane, but if space is star-filled without limit, we can keep on the process of extending our study to stars which look a quarter as bright as the last lot, as many times as we like, and each time we do so we shall double the total light of all the stars in our list. However small the light of the first set of stars may be, as it is doubled and doubled and doubled again, the result will increase without limit.

SO we come to the conclusion that if our assumptions were correct the total light of all the stars would be infinitely great! This is obviously absurd, and before going so far we would have to take into account that the stars are opaque and that some might hide others. What we find, then, is that if space were sown uniformly everywhere with stars, any arbitrary line of sight drawn from our eyes in any direction would sooner or later hit a star surface and the star-disks would cover the whole heavens, overlapping at last and hiding all that lay behind. Consequently the whole surface of the sky would shine like the Sun. The difference between a moonless night and a light ten thousand times that of the noonday sun therefore measures the extent to which the supposition with which we have been playing is removed from the truth.

What we actually find is that the number of faint stars although increasing steadily, does not multiply nearly as fast as our previous over-simplified theory would indicate. Even in the Milky Way the difference is conspicuous, and in the regions of the sky remote from the Galaxy it is still greater.

In telling a story like this there is "safety in numbers"—they are more intelligible than words. So we may

| | SCALE OF UNIVERSE. | | |
|---|---|---|---|
| -9 | .000 000 000 000 06 in. | $1.6 \times 10^{-13}$ cm. | Electron. |
| -8 | .000 000 000 006 in. | $1.6 \times 10^{-11}$ | |
| -7 | .000 000 000 6 in. | $1.6 \times 10^{-9}$ | |
| -6 | .000 000 06 in. | $1.6 \times 10^{-7}$ | Atom. |
| -5 | .000 006 in. | $1.6 \times 10^{-5}$ | Soap Bubble. |
| -4 | .000 6 in. | $1.6 \times 10^{-3}$ | Tissue Paper. |
| -3 | .06 in. | $1.6 \times 10^{-1}$ | |
| -2 | 6.3 in. | $1.6 \times 10$ | |
| -1 | .01 m. | $1.6 \times 10^{3}$ | |
| 0 | 1 mile | $1.6 \times 10^{5}$ | |
| 1 | 100 m. | $1.6 \times 10^{7}$ | |
| 2 | 10 000 m. | $1.6 \times 10^{9}$ | Earth. |
| 3 | 1 000 000 m. | $1.6 \times 10^{11}$ | Earth Moon. |
| 4 | 100 000 000 m. | $1.6 \times 10^{13}$ | Earth Sun. |
| 5 | 10 000 000 000 m. | $1.6 \times 10^{15}$ | Solar System. |
| 6 | 1 000 000 000 000 m. | $1.6 \times 10^{17}$ | |
| 7 | 17 light years | $1.6 \times 10^{19}$ | Nearer Stars. |
| 8 | 1700 l.y. | $1.6 \times 10^{21}$ | Local Cluster. |
| 9 | 170 000 l.y. | $1.6 \times 10^{23}$ | Galaxy. |
| 10 | 17 000 000 l.y. | $1.6 \times 10^{25}$ | Nearer Spirals. |
| 11 | 1 700 000 000 l.y. | $1.6 \times 10^{27}$ | 6 times Range 100 in. |
| 12 | 170 000 000 000 l.y. | $1.6 \times 10^{29}$ cm. | Einstein Universe. |

Courtesy Journal of the Royal Astronomical Society of Canada

TABLE OF DIMENSIONS OF THE UNIVERSE

*The figures quoted for the Galaxy agree in order of size with those of Kapteyn, quoted by Dr. Russell*

well quote some results obtained two years ago by Seares and van Rhijn. From the extensive tables, we take the number of stars in an area ten degrees square, which are brighter than a given magnitude, first in the circle of the Milky Way; second, as far as possible from it.

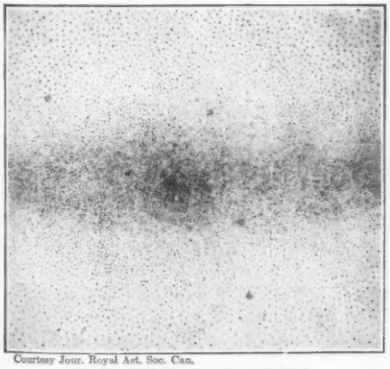
| Limit by Magnitude | Milky Way | Galactic Pole |
|---|---|---|
| 6 | 13 | 4 |
| 7½ | 60 | 17 |
| 9 | 280 | 72 |
| 10½ | 1260 | 280 |
| 12 | 5500 | 1000 |
| 13½ | 23,400 | 3100 |
| 15 | 91,000 | 8700 |
| 16½ | 324,000 | 21,800 |
| 18 | 1,020,000 | 48,000 |
| 19½ | 2,900,000 | 95,000 |

EVEN for the brighter stars the increase in number as we lower the limit of inclusion by one and one-half magnitudes is only four or five fold, instead of eight fold; and when we come to the faintest ones the numbers are not quite trebled in the Milky Way and a little less than doubled at its pole.

The meaning of these numbers is not far to seek. As we pass from each group of stars to the next we include all that we had before, but we add fainter ones which, as we have already seen, lie in more distant regions. Since we do not increase our star numbers eight fold, these outlying regions must be more thinly peopled with stars than are those near the sun.

So we know that the star distribution thins out at a great distance. What is more, we can calculate how much it thins out.

If the stars were all of the same real brightness this would be a matter of



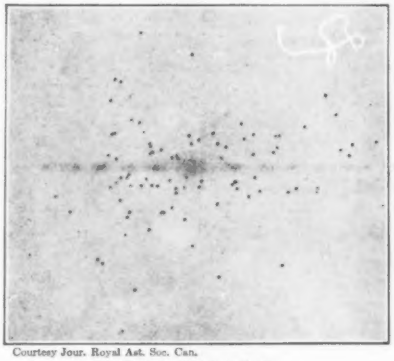
Courtesy Jour. Royal Ast. Soc. Can.

THE LOCAL CLUSTER

*According to Shapley, the Sun is in a local cluster 5000 light years in diameter*

simple arithmetic, for in that case all those which looked faint would be distant and those which looked bright would be near. But the great diversity of actual luminosity among the stars complicates the problem.

Among the stars of the first magnitude, for example, some like Rigel or Canopus are large bodies at vast distances, while Alpha Centauri and Procyon are smallish stars very near us. It is still possible to solve the problem by fairly difficult analysis, if we risk the assumption that the relative proportions in which bright and faint stars are mingled in space is the same in remoter regions as it is near the Sun. It is then found that outside the Milky Way the stars which look very faint in the heavens are really dwarfish. A star of the 18th magnitude, for example, if really as bright as the Sun, must be at a distance of 15,000 light years; if as bright as Vega, at 100,000



Courtesy Jour. Royal Ast. Soc. Can.

THE GALAXY

*The crosswise streak represents plane of the Galaxy; the dots are globular clusters*

light years. At even the smaller of these distances, except in the direction of the Milky Way, the line of sight runs out into an outer region almost empty of stars. Hence, except in the Milky Way, the 18th magnitude must practically all be dwarfs and much fainter than the Sun.

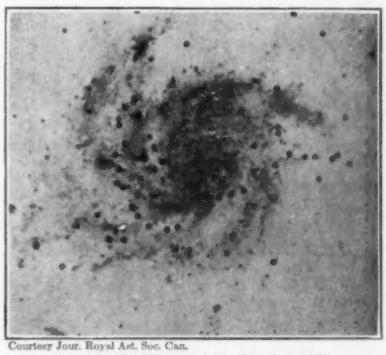
DIRECT evidence of this is found in the fact that measures of color show that all these faint stars are red, as the dwarfs are. The best computation of the extent of our galactic universe is that which was completed by a Professor Kapteyn in 1922, not long before his lamented death. Working out separately for different distances from the Milky Way, i. e., (galactic latitudes) the density of distribution of the stars at different distances from the Sun, he found that the form of the system is that of a greatly flattened ellipsoid something like a thin, round cake of soap whose diameter is a little more than five times its thickness.

The vast cluster has no sharp boundaries or limits, but thins out gradually. The central region within which the average distance of neighboring stars is not more than one third greater than in the densest part, is about 6600 light years in diameter and 1300 thick. The region within which the star density is more than one eighth that at the center, and the average distance between stars not more than twice as great, comes out 16,000 light years in diameter and 3000 thick; while stars may still be found, though scattered a hundred times more sparsely than at the center, throughout a region 55,000 light years in diameter and 11,000 light years in thickness.

This "Kapteyn universe" gives much the best picture of our universe of stars which is yet available. It is admittedly of a generalized nature—no account is taken, for example, of the possible differences in distance of the limit in different regions of the Galaxy; that discussion was reserved for a second approximation which the distinguished author did not survive to make. He did conclude, however, that our Sun is about 2000 light years from the center of the system.

A MORE detailed study of the size and shape of the universe, by these statistical methods, although quite possible, involves very heavy work, both in obtaining accurate counts of the numbers of very faint stars and in mathematical analysis. A direct road appears, however, to be open, through the observation of faint variable stars. A systematic survey with the aid of suitable photographs of the star clouds of the Milky Way and of typical regions all over the heavens, would undoubtedly result in the discovery of great numbers of faint variables. Many of these should be cepheids, and when we know the period of a cepheid, we can find at once its true brightness and its distance.

Plans for surveys of this sort are well under way, if indeed the work has not been begun. Within a decade or less we may hope for a great extension of our knowledge, and it is not over-bold to dream of a day when every text-book of astronomy may



Courtesy Jour. Royal Ast. Soc. Can.

HYPOTHETICAL GALAXY

*This is the same concept shown in the upper drawing but shown here as a plain view*

contain a map based on trustworthy data, showing the outline and limits of the visible galactic universe.

¶ *It may interest our younger readers to know that Dr. Russell began contributing to the SCIENTIFIC AMERICAN in 1900, when still in college.*

BALCH POWER PLANT

*In a setting of high granite cliffs and green mountains, this powerful new hydro-electric plant looks like a toy house in a land of make-believe. The huge penstock seen on the side of the cliff at the left, is extended under the river in a concrete bed*

# America's Greatest Water-wheel

## *With a Head of 2243 Feet, Balch Power Plant Is Highest Head Plant in America*

By CHARLES W. GEIGER

ALONG the eastern rim of the great San Joaquin Valley in California there looms a background of mountains rising to a tremendous height. During the winter months these mountains, reaching elevations of 14,501 feet, are covered with a blanket of snow that slowly melts and runs off into thousands of little brooks and streamlets, feeding into small streams that wind their way toward the floor of the valley.

One of the largest rivers formed by the mountain snows is the Kings. From a purling stream that a child might step across, the Kings River within a few hours sometimes becomes a roaring torrent, 40 feet deep, boiling high over boulders as big as a five-room house. Kings River reaches the valley level about 25 miles east of Fresno, where it spreads out through hundreds of miles of canals over 400,000 acres of land, supplying water for irrigation.

Because the snow melts early in the summer, the runoff is at its peak in June and drops rapidly to the minimum flow by the first of August. During the high runoff period much water is lost, running away to the Pacific Ocean.

The north and west forks of the Kings River pass through a series of high meadows or plateaus at elevations of 4000 to 8000 feet. Deep canyons cut by the water on its way to lower levels have created ideal reservoir and dam sites, where the excess water may be stored for a longer irrigation season and for the development of power.

In an area of approximately 100 square miles, embracing the watersheds of the north and west forks of the Kings River, the San Joaquin Light and Power Corporation has planned the Kings River project, its major hydro-electric power development to supply power for the future demands of the San Joaquin Valley. Surveys show that it is possible to develop 495,000 horsepower by conserving the water in high reservoirs and diverting the streams through a series of power houses.

CONSTRUCTION work was recently completed on Balch power plant, the first unit of the Kings River project. This power plant contemplates no storage reservoir for its present operation, water from the north fork being diverted by a dam through 19,350 feet of 12 by 12 foot tunnel to the power house, in the canyon of the river. Forty thousand horsepower will be developed in this first unit, the ultimate capacity of the Balch plant being 160,000 horsepower, generated in four units.

The water driving the water wheels has a head of 2243 feet, giving it the distinction of being the highest head plant in America at this time. The impact of water on the buckets drives the water wheels at 360 revolutions per minute, the buckets traveling at the rate of 141 miles per hour. Through the seven and one eighth inch cast-steel nozzles directing the stream of water against the buckets, 90 cubic feet of water will pass per second. The pressure at the nozzle will be 971.2 pounds per square inch. This tremendous force of water coming through the tunnels and penstocks will develop 20,000 horsepower on each water-wheel.

Electric current is produced through a generator mounted between the water wheels on a 31-foot shaft, 22

inches in diameter. This is said to be the largest capacity that so far has been built into a generator of its type. The rotating elements of the generator and water wheels weigh 170 tons, all on one shaft. The generator is 12 feet, six inches wide, 19 feet, six inches in diameter, and projects 12 feet above the power house floor. The energy is generated at 13,200 volts which is stepped up through a bank of transformers to 132,000 volts for transmission. Each complete water-wheel runner is 11 feet in diameter and weighs 15½ tons. The runners are composed of forged steel disks, six inches thick and eight feet, four inches in diameter. Twenty-two cast steel buckets, each weighing 800 pounds, are fastened to each disk.

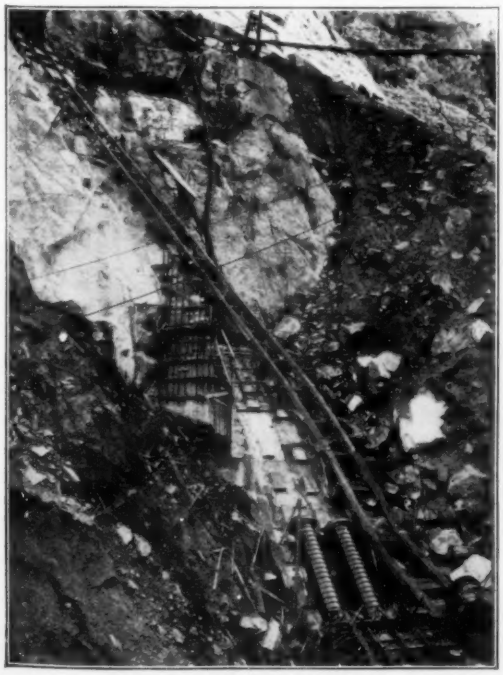
THE operator's room on the mezzanine floor of the power plant overlooks the floor, while the giant transformers and switching gallery outdoors may be observed through windows. Three switchboards place under the hand of the operator control of the huge generator, exciters, valves and gates, transformers, and disconnecting switches located at the base of a 90-foot steel switching structure. These switches are marvels of ingenious wiring and automatic registering devices. Each operation is indicated by red or green colored lights which show at a glance just what is taking place in the switching and flow of power.

The controlling mechanism of the power house embraces the latest design in automatic devices. Water entering the penstock is regulated by a butterfly valve, operated by electric motors controlled from the power house. Automatic governors regulate the flow of water through the nozzles for the purpose of maintaining a constant speed of 360 revolutions per minute in the generator, under all loads. To protect the penstock against sudden rises in pressure, caused by closing of the needle valves by the governors, two pressure-regulating relief valves are employed. Each pressure regulator is automatically opened as the needle valve closes, thereby preventing excessive pressure rises. Two huge main-gate valves operated from the control board may be used to shut off the water before it enters the nozzle control. These valves are hydraulically operated, each weighing 25 tons.

PENSTOCK ON CLIFFSIDE

*Study of this photograph will show the difficulty of the feat of installing and anchoring the weighty 60-inch penstock*

One of the most difficult feats connected with this project was the assembling of the penstock connecting the power house with the 19,350 foot tunnel. On account of the steepness of the canyon, there was no site for a power house on the penstock side and it was decided to cross the river with the pipe. In placing the penstock under the river some interesting engineering features were involved. A trench was cut in the rocky bed four to six feet deep in which the pipes were buried in concrete. For additional security, three rows of one-inch steel dowels, placed 30 inches apart, were sunk into the rock 15 feet under the concrete anchorage. These were tied into the heavily reinforced concrete, thus forming additional anchorage against the force of flood waters in the river.



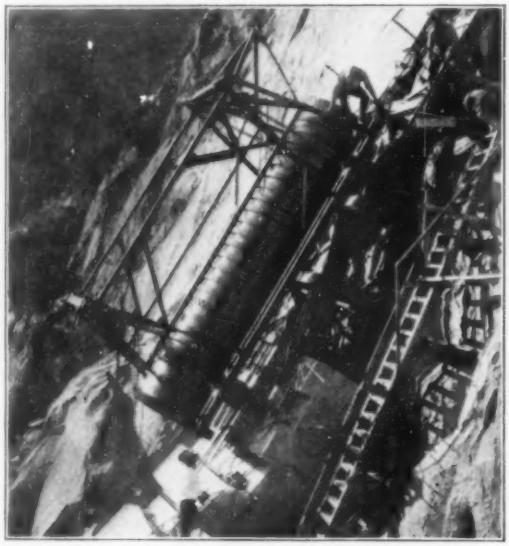
VIEW AT BASE OF CLIFF

*Before passing under the river in a bed of concrete, the penstock divides into two 34-inch pipes as shown here*

The penstock line consisted of more than 200 lengths of tubing, varying in weight from seven to 10 tons each. These were trucked around the cliffs to an incline railway, paralleling the penstock line. More than 5000 feet of specially made steel cable was wound around the huge drum of the incline hoist at the top of the grade. Each length of pipe was numbered to go into a certain place on the line and none was interchangeable. A novel device, developed to handle the difficult problem of placing the pipe in its proper position on the steepest points on the side of the cliff, consisted of a crane mounted on four wheels traveling on rails. The heavy pieces of pipe were swung in chain slings suspended from four four-ton hoist blocks. By means of this control the pipe was lowered without difficulty to the exact position where it should rest.

THE great tube of steel, like a huge black snake, stretches from the tunnel to the power house, a distance of 4854 feet. The pipe was fabricated in Poland, where special processes have been developed for producing a high grade of heavy-duty tubing. About half way down the mountain side, the pressure becomes so great that the pipe is banded with steel hoops shrunk on at the factory. The strength of the pipe is increased by heavier bands and tubing as it nears the power house to withstand at the lower end a maximum pressure of 1030 pounds per square inch.

While the penstock rests on concrete piers placed 30 feet apart, the problem of holding the line in place is solved by using massive reinforced concrete anchors, the largest being 42 feet long and 29 feet high. This anchor, placed at a bend in the line where the pipe is almost perpendicular, weighs 1,650,000 pounds and is designed to resist a horizontal thrust of more than one million pounds. The penstock line is 60 inches in diameter



**PENSTOCK SECTION**

*A length of the penstock tubing being swung into place. Each section weighed from seven to 10 tons each and necessitated the development of a special device for handling. This consisted of a crane mounted on four wheels which traveled on rails down the mountainside, the whole being lowered into position by an incline hoist at the top of the cliff. Sections were all numbered for location and no lengths were interchangeable. Steepness of the incline, and the large size of the pipe and concrete anchoring beds may be noted from this unusual photograph*

at the tunnel and decreases in size to 48 inches at a point 250 feet above the power house, where it is divided into two 34-inch pipes which pass under the bed of the river to the power house.

Because of the variation in temperature, the pipe must have provision to expand and contract lengthwise. With a variation of 100 degrees, the total expansion from the 19,350 foot tunnel to the power house is estimated to be three feet, two inches. If the pipe were laid rigid it would soon buckle and force itself out of place as it expanded. To avoid such disastrous consequences, expansion joints were provided at each of the 14 anchors. Movement of the pipe on the supporting piers is made possible by a slip-shoe of steel bolted to the pipe which slides on a curved saddle bolted to the pier. Heavy grease is spread between the shoe and saddle for lubrication. The longest section between anchors will have an estimated maximum expansion of five and one-half inches.

THE 12 by 12 foot tunnel, 19,350 feet long, is cut through the solid granite of the mountain, following the contour of the ground. It has a fall of three and three-tenths feet to the thousand, the intake being approximately 65 feet above the discharge. The diversion dam is an arch type, solid concrete structure, 60 feet high above the stream bed, 95 feet above the deepest bedrock, and 220 feet long at the crest. It is set in a narrow canyon, resting on solid rock walls. This dam is merely intended to divert the stream through the tunnel and will cause practically no water to be held back from the stream, as the reservoir has a capacity of only 125 acre-feet. Another reservoir of equal capacity located a short distance below the power house will equalize any variation in the stream flow after discharge from the wheels.

Cut in one solid rock of the mountain near the end of the tunnel is a chamber shaped like a gigantic hour glass, 165 feet high and 16 feet in diameter at its narrowest point, and 28 feet at its base and top. This is known as the surge chamber or forebay, and provides a means for relieving sudden pressures that may be thrown on the penstocks as a result of closing the valves or gates. At the end of the tunnel a steel pipe or manifold ten and one half feet in diameter is concreted into the solid rock of the tunnel walls. This pipe is provided with four outlets 60 inches in diameter which feed directly into the penstock. Three of these outlets will be closed, awaiting future use when other units are added to the power house.

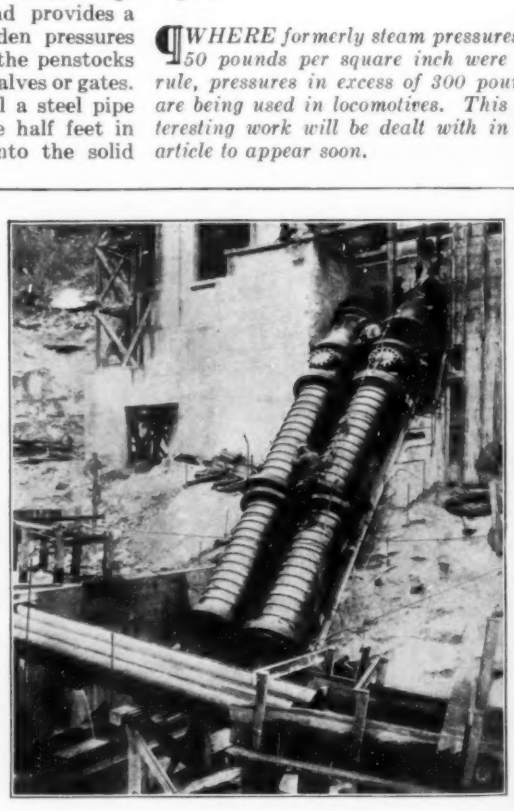
Near the entrance to the manifold and at the base of the surge chamber is a pit to trap sand and small particles of rock. A small piece of rock descending through the penstock would strike the water-wheel buckets at a velocity of more than 245 miles per hour, with the possibility of causing damage by scoring or even smashing buckets.

THE Balch plant is the first unit of an ultimate possible development of 495,000 horsepower through a series of dams, reservoirs and power houses on the north and west forks of the Kings River. This great project was conceived 13 years ago by A. G. Wishon, President of the San Joaquin Light and Power Corporation, who spent several years in preliminary surveys and study of power possibilities in the Kings River country. The Kings River, with its forks, is practically the last of California's large rivers to be harnessed for generating electric current, to be used for light and power in the great San Joaquin Valley and elsewhere in conveniently situated localities of the Pacific Coast region.

¶ *WHERE formerly steam pressures of 250 pounds per square inch were the rule, pressures in excess of 300 pounds are being used in locomotives. This interesting work will be dealt with in an article to appear soon.*

**INTO THE POWER HOUSE**

*These twin tubes, where they enter the powerhouse after passing under the river, must withstand the tremendous pressure of 1030 pounds per square inch, due to the weight of the column of water from the tunnel above, the head being 2243 feet. They must be capable also of taking care of the great pressure caused by a sudden cutting off of the water. At the lower left-hand corner of this picture is the point of entry of the penstock into the concrete bed under the river. The size of these tubes through which 90 cubic feet per second will pass may be noted by comparing them with the workman*



# A Crusader's Fortress Excavated

## *A Glimpse of an Old Warrior's Castle in Palestine Is Afforded by the Results of Recent Work*

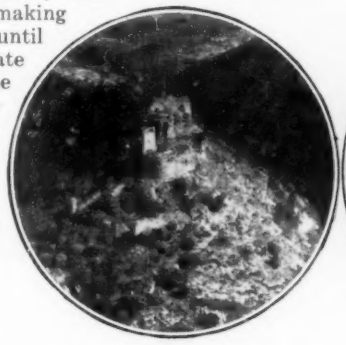
THERE is a strong fascination about the Crusades. What memories of Godfrey of Bouillon, Richard Coeur de Lion, Saladin, are brought up by the very name. The "Talisman" and "Ivanhoe" contribute largely to this glamour of history, chivalry, and adventure. Archeologists were well aware that the castles which were erected by the Crusaders at strategic points contained infinite treasures, but there was no hope of making explorational studies until England took the mandate for Palestine, for under the Turkish regime all excavations were forbidden.

Dr. Bashford Dean, Curator of Armor of the Metropolitan Museum of Art, visited Jerusalem in 1925 and a consultation was held with the English officials.

IT was decided that the most promising site for a preliminary survey was the Crusader's fortress of Montfort, half way between Acre and Tyre, and only about six miles from the sea. From it, or by it, passed a trail or highway to the southeast leading to the Sea of Galilee, thence to the Valley of the Jordan and Jerusalem. The castle was French until 1229 when it was deeded to the Grand Master of the Order of the Hospital of Our Lady of the Teutons. It was destroyed in 1291.

In the winter of 1926, a permit to excavate was issued by the Department of Antiquities in Jerusalem. Funds were subscribed, and Mr. W. L. Calver was secured to direct the work in the field. Mr. Calver has gained great reputation for his brilliant researches of Indian and British sites in Manhattan Island and elsewhere. Work was begun in March, 1926, and continued for a month, after which the specimens were divided.

Dr. Dean's account of the exploration appears in a special report issued by the Metropolitan Museum of Art.



THE CASTLE

*General view of the castle from the west. The location on the hill is glorious*

BASE FOR VAULTING

*Central column of the so-called "residence" from which the vaulting sprang*

We condense Dr. Dean's article, using his own illuminating language almost entirely, but naturally only a part can be used. The complete report is readily obtainable.

The site of the castle must have caused professional satisfaction to medieval engineers. It is an abrupt shoulder of a hill, jutting out between the arms of the stream Wady Kurn, which flows southwest into the Mediterranean. It is the natural place for an acropolis, 600 feet higher than the stream, almost precipitous on its western end, and sloping by easy stages toward the east, thus furnishing desired changes of level in an approach to the castle. In its position Montfort has numerous analogies of similar date in Europe from Scotland to Spain (Segovia), notably in eastern France and western Germany.

The rounding wall, or curtain, and the tower mark an important retaining wall; the masonry behind it and at the right of the tower was a great square building; one sees here the farther wall of it marked by two arches. Part way down the hill are the remains of surrounding walls with curtain towers; these appear, however, only on the left (northwest) side of the castle, those on the steeper or south side having disappeared.

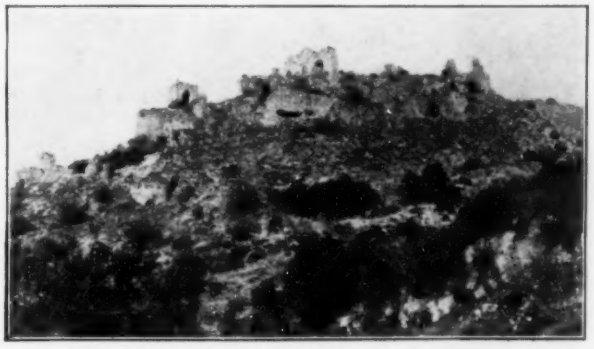
IN ancient times a road proceeded on either side of the base of the promontory toward the horizon directly behind the castle, and led the pilgrim through ancient villages to the Sea of Galilee, 20-odd miles away.

To understand the disposition of the present ruin, we have only to review the plan of an early Thirteenth Century fortress such as, for example, Coucy, not far from Laon. This comparison makes clear that the great square building enclosing *K* and *L* (see plan) of the survey is the residence (palace) of the castle. The space to the left (east) is the inner bailey, (outer court of a castle) which was enclosed on the north by a wall or curtain of which only a part is still preserved (80 feet to the east). The construction

All photographs courtesy Metropolitan Museum of Art and W. L. Calver

PREPARATION FOR FIELD WORK

*The camp was pitched on the side of the hill in sight of the ruin of the castle. Notice the camel between the two nearest tents*



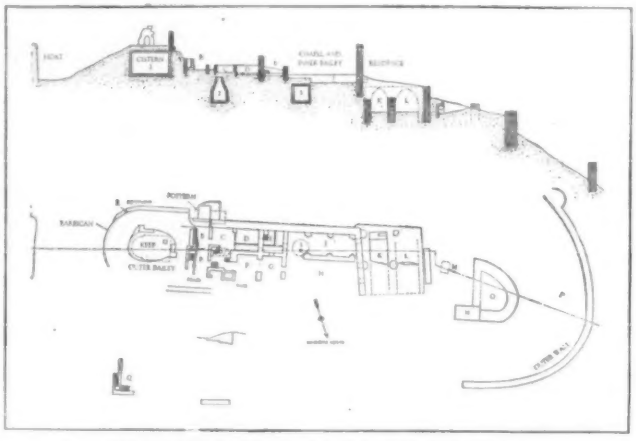
MONTFORT FROM THE SOUTHWEST

*This is how the ruin looked before the excavations began. A few weeks later the hillside was covered with debris cast down*

*J* becomes the chapel of the castle, an identification supported by architectural and other evidence; for example, the finding here of numberless fragments of stained glass. The wall which forms the eastern boundary of the chapel, and of the inner bailey, separated the residence of the castle from the soldiers' quarters, the shops and the outer bailey, or space surrounding the great keep, which formed the eastern end of the citadel and served for maneuvering the retainers of the castle.

THE front wall (barbican) of the outer bailey was pierced by a great gateway. Bridges and drawbridges led over the ditch, or fosse, which, in Palestine, was doubtless dry, and used only as a trap against besiegers. Somewhere in this neighborhood must also have been a postern gate which would enable the garrison to make sorties in time of need—perhaps at the point of the wall of the castle at the side of a wall of retention, or revetment, shown on the south side and forming here the boundary of the barbican.

Better to understand the topography of the fortress, let us keep in mind its ground plan and section (shown in the line drawing), and then, like visitors, pass through it from end to end. We follow the path coming in from the west, which curves around the south side of the ruin, then work our way up the side of the hill. Here we pitch our camp and, looking upward at the ruin, we see at the left (west) the retaining wall and tower which marks the "garden" of the residence. At the top a transverse wall frames two great arches and marks the east wall of the residence whose block of masonry here forms a sharp corner; on the face (south) of this masonry we see two deep fissures or excavations running close and parallel to the foundation; these date from 1271 when the Sultan undermined the walls. We imagine with what heroism the Saracens, high up on a narrow ledge, maintained their position against the operations of the Hospitalers whose heavy rocks, dropped from 50 feet above, must constantly have crashed through the mantlets, enabling the German archers and crossbowmen to pick off survivors as they scurried down the steep hill.



SECTION AND PLAN OF THE CASTLE

*This section and plan is of great interest. It shows the disposition of the offices of a great castle at the beginning of the Thirteenth Century*

CONTINUING to clamber up the hill and to the right, we glance at the great blocks of limestone which form the base of the keep, blocks which probably date back to Roman times, if not earlier. Also, above these great stones, at the left, in the neighborhood of the clump of trees, we seek for the position of the postern gate. We next reach the deepest part of the moat near its steep east wall; thence we climb to the keep over the masonry of the barbican. We find that the keep itself has crumbled away; vestiges of only its lower structures remain.

Now, turning and facing north, we obtain a fine view of the valley. Deep below us lies the Wady Kurn which forms a bend to the east where in early times may well have been a great mill pond at whose dam almost directly below us lies the ruin of a "mill" or "chapel" or "guardhouse." Next we go down into the castle by a flight of wide stone steps. At the bottom we find a stone platform which runs across the castle. We examine at close range the great blocks forming the base of the keep, numbers of stone projectiles for artillery, a great tank of stone (watering trough for horses?), a drain taking refuse down the side of the hill, sculptured arches, Thirteenth Century carved capitals.

Before our excavations, had we stood on the mound of the keep and looked westward, we could have seen at a distance of 60 yards the transverse wall marking the nearer boundary of the residence; behind it, the top of the tower; and running toward it, a backbone of heavy masonry.

THIS portion of the castle is indicated at *B*, *C*, *D*, and *E* in the plan, where a number of chambers were found which Dr. Dean describes in detail in his report. Chamber *C* was probably a kitchen for the garrison, as in it was found an array of great earthen vessels, some of them set up and in order, all clearly for provisions. In one corner of this chamber there may have been a booth for drugs, for here were found a mortar in an upright position and numberless fragments of small bottles or flasks. In chamber *F* the armor was probably repaired, for here were found blooms of iron, a crucible, tools, and fragments of armor.

The chapel measured about 70 by 25 feet, broken into three sections by groined arches. Scattered about were a number of great round stone projectiles averaging 13 inches in diameter which were doubtless shot into the chapel at the time of the siege; the stained glass which probably existed on the south as well as the north side, proving a tempting mark for the besiegers. The great wall of the residence separated the master's quarters from the rest of the castle: here were the rooms of ceremony; probably the

STAIRCASE IN THE FORTRESS

*This massive staircase of wide stone steps descended from the keep into the castle*

CAPITALS AND STONE BALLS

*This picture shows the stone balls cast by huge revolving slings or "trebuchets"*

treasury of the Hospitalers and their hall of archives, together with the room of the Grand Master—the "brothers ordinary" lodging in the rooms *D* and *E*, the latter communicating with the chapel. The residence was practically a building by itself: it measured 60 feet square and at least 70 feet high, having walls six feet thick. A great capital borne by a wide octagonal is to be found in this location. It is clear that there was a groined roof that spanned the 50-odd feet and this was the control column.

BACK of the residence we expected to find, thanks to European analogies, the garden of the castle. Here we found an enclosure 60-odd feet in diameter, which may have been of such a nature; its retaining wall was roughly semi-circular and of great strength, 12 feet in thickness. At one side (north) of it is still retained the fine tower, prominent as we approach the castle from the west; the only well-preserved tower of the castle, unaccountably well preserved, when we recall that it was on this side of the fortress that the besiegers gained their entrance. This tower is of special significance, since although not high (56 feet on the north side) it exhibits in all probability the essential architectural features of other (if not all other) towers of the castle—small windows, loopholes, and entrance ports on the outer facade and, toward the inside, deep-set balconies with high ceilings which provided grateful shade—as one sees in numerous crusading castles, for example, Rhodes. The block of masonry, by the way, which surmounts one corner of our tower, is possibly the last evidence of the type of machicolations that crowned the towers of the Crusader's fortress of Montfort.

THE DIRECTOR AT WORK

*Mr. Calver's experience in excavating on various sites fitted him for his task*

SAWING A ROSETTE

*The workpeople are shown sawing off surplus material. The architectural sculpture found at Montfort yielded important notes as to Thirteenth Century ornaments — capitals, corbels, keystone ornaments and crockets. Montfort is of high quality as regards these architectural features. It would be difficult to find better stone ornaments of this period in any of the castles of Western Europe, save of the highest rank. There are also evidences of polychrome decoration in the castle*

Had the castle an outer ring wall? This probably existed, judging from contemporary analogies, though it may have been little more than a mound surmounted by a palisade and enclosed with a ditch. There exist certain indications of this: notably the bridgehead (south), and the important ruin to the north (Kitchener's "mill") at the dam of the Wady Kurn, by which a lake—probably a thousand yards long—was created. The "mill" we have already looked down upon from the wall of the castle: it was, in fact, so large and costly a structure that it would hardly have been left outside of a ring wall in a country subject to constant incursions of a formidable enemy.

There is a tradition at Montfort that a covered way ascended from the "mill" to the castle, and Kitchener states that here was a part of an aqueduct. In any event, there was means for filling cisterns on the hilltop.

Of the cisterns in the castle, three were explored. The largest of these was under the keep and was a great cemented chamber 40 feet in length, 28 feet wide and over 20 feet deep. It was built with walls of masonry with a smooth lime-cement finish. The second cistern was located under the kitchen. This was a bottle-shaped affair about 16 feet in transverse diameter and 20 feet deep. The third cistern, cylindrical in shape and about 15 feet both in diameter and height, was under the chapel near the entrance.

THE objects found occupy about one half of Dr. Dean's report which describes (1) architectural ornaments, (2) other carvings in stone, (3) pottery, (4) arms and armor, (5) various objects in metal and wood, (6) glass, (7) tissues, (8) coins. These specimens were obtained in almost every instance in the debris removed from various chambers of the castle. While Dr. Dean does not feel that further work would be fruitful in his special field of arms and armor, still this does not imply that the great castles of Palestine do not deserve careful exploration from other archeological viewpoints. As a study of manners and customs such explorations are of great interest. A part of his last paragraph is as follows:

"THE outstanding feature in the present study is the evidence that the knights of Montfort were living not under conditions of stress or hardship, but on very much the same material level which they would have occupied in western Europe. The objects about them were of similar quality, and the luxury in camp in Palestine would scarcely be less than among the besiegers of Peronne or of Carcassonne. In the matter of the concrete results of our reconnaissance, our regret is only that well-preserved specimens of artistic importance were not forthcoming. But our work extended over so short a time (a month) that we could hardly have expected better results. In arms and armor, our special interest in the present trip, little was found which, from the Museum's viewpoint, could be regarded as material for exhibition."

THE OLD MILL

*The old mill at the foot of the castle hill was of large extent. Its ruins are shown here*

# The Month In Medical Science

## *A Review and Commentary on Progress in the Medical and Surgical Field*

By MORRIS FISHBEIN, M. D.
*Editor of the* Journal of the American Medical Association *and of* Hygeia

### Sunlight and Skyshine

MUCH has been written as to the effects of the ultra-violet rays of the sun in benefiting the disease rickets and in its treatment. Drs. Frederick F. Tisdall and Alan Brown of Toronto have been among the leaders in the conduct of scientific investigations to determine the exact value of light from the sun under various conditions. It has been shown for instance by observers that more ultra-violet rays are available from the sun in such cities as Chicago, Pittsburgh and New York between the hours of 11 and 2 than any other time during the day. Furthermore, little ultra-violet comes direct from the sun from the months of October to May, inclusive.

The Canadian investigators have found that the sun's rays during December, January and February in the latitude of Toronto have only a slight anti-rachitic effect. A sharp increase occurs about the first of March and the effects in April and May are about eight times as great as in December, January and February. Apparently the increase is due not so much to an increase in the amount of the rays present as to the presence of rays that are shorter than those available in the winter.

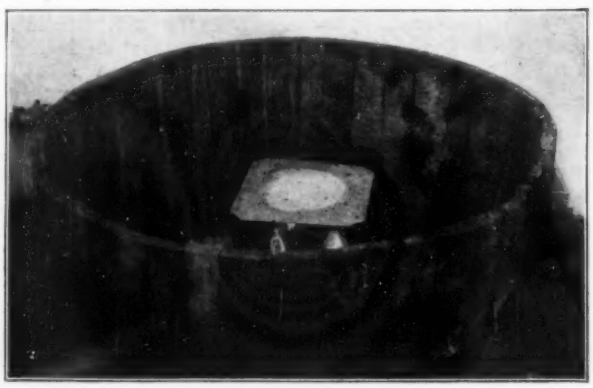
The anti-rickets effect of skyshine reflected from the sky is approximately from one half to two thirds as great as that produced by what is ordinarily termed sunshine.

In their experiments, the Toronto investigators developed much special apparatus, including especially a cage to supply the rats used in the experiment with heat. It is a tub which serves as a windbreak and a glass covered enclosure with which the power of various glasses to transmit rays could be determined.

They found that the anti-rickets effects of the sun's rays, including the sky shine, through vitaglass, vioray glass and corning glass is from 25 to 50 percent of the anti-rachitic effect obtained without the use of glass. Little, if any, ultra-violet rays pass through ordinary window glass. When rooms are fitted with special glass, the effects are slight, indeed almost negligible, except immediately adjacent to the window. They concluded that it is necessary to receive the direct rays of the sun through an open window or through a window glazed with special glass in order to obtain the benefit of the rays, and that therefore the use of the special glasses during the winter months is probably of little, if any, value, particularly in northern latitudes.

### X-ray Effects on the Heart

SINCE it was first learned that the X ray is powerful for evil as well as for good when applied to living tissue, physicians have been extremely careful in their application of this agent to the treatment of disease. An especially serious point that had been raised concerned the question as to whether or not the X ray would injure the muscle of the heart when the chest was exposed to its influence.



PLAYING WITH SUNSHINE

*Part of the equipment for the experiments with rats, described in these columns. A heating element is built inside the tub and the cage is placed over the heater. The tub acts as a windbreak for the latter*

In order to settle this point, Drs. A. S. Warthin and E. A. Pohle of the University of Michigan tested the effects of the rays on rats and on rabbits. The region over the heart of these animals was exposed to X rays of short wavelength, such as are used in instances when the X ray is used to treat tumor growths beneath the surface. Later the organs of the animals were examined both grossly and under the microscope. Symptoms representing signs of injury were not observed during the exposure and there were no changes visible at post mortem examination indicating that damage had been done.

In the case of one of the rats, there were microscopic changes in the heart muscle which seemed to indicate possibilities of dosages that were too large. However, the evidence seems to be conclusive that a single exposure of the region of the heart to the X ray in the amount and for the duration usually used does not produce any definite injury to the heart muscles.

### Cereals in the Diet

WORKERS in the department of physiologic chemistry in Yale University have recently completed a series of studies on the use of cereals as the chief source of calories in the human diet. The cereals are easily digestible and readily available, but are not considered perfect or complete foods. Because of the richness in carbohydrates or sugars, they are believed to have special value in providing fuel for the heat requirements of the body. Studies made by statisticians indicate that the American people secure approximately 35 percent of their calories from cereals, whereas the average Chinese diet provides from 60 to 72 percent of its energy in the form of cereals.

Dr. George R. Cowgill and his associates in Yale University used in their experiments exceedingly large amounts of rolled oats, whole wheat and yellow cornmeal. It was found in general that when suitable adequate supplementary foods are used, cereals may be taken to furnish as much as 84 percent of the necessary calories in the diet, and that such a diet is compatible with excellent growth, reproduction and general physiologic well-being in the animal. If the diet is otherwise balanced, such as may be accomplished by eating lettuce, liver, cod-liver oil or other substances providing the vitamins in which a cereal diet is somewhat deficient, the animals do very well. Of course, it is not possible to apply especially to man the results of

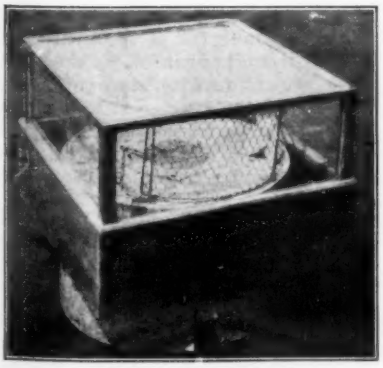
feeding experiments on the rats, but so far as they have gone these experiments indicate the extreme usefulness of cereals in a human dietary.

Experiments were carried further to determine whether or not it would be possible to make a satisfactory diet largely of cereals without milk. The experiments on rats showed that diets in which cereal constituted 80 percent of the mixture, the remainder made up by cooked whole egg, molasses and fresh lettuce, served also satisfactorily for proper growth and development.

### High Altitudes

E. C. SCHNEIDER, who made a study during airplane flights, of the effects of high altitude on the human body, pointed out the importance of lowered atmospheric pressure, partial pressure of oxygen, temperature, humidity, increased intensity of sunshine and changes in electrical conditions as of importance in making high altitudes uncomfortable for human beings. Of most importance is the diminished partial pressure of oxygen, which results in imperfection of the aeration of the blood in the arteries. When insufficient oxygen comes to the lungs, the amount of oxygen in the blood is abnormally low. The blood that reaches the central nervous system is unsatisfactory for maintaining it in proper condition and the human being suffers with mountain disease, aviator's disease, or whatever one chooses to call the collection of symptoms included by these names.

When a person has been at a high altitude for an unusual period, the



TESTING THE GLASS

*The specially constructed frame for holding the glass to be tested, fits over the rat cage and the latter fits in the tub.* *See page 128*

body tends to compensate for these difficulties. In the compensation, according to Schneider, there is an increase in the ventilation of the lungs; in the percentage and total amount of red coloring matter in the blood, the latter being responsible for carrying the oxygen; a change in the chemistry of the blood, and an increase in the heart beat. All of these factors tend to aid the circulation of oxygen to the tissues.

The expedition of the Duke of Abruzzi to the Himalayas in 1909 reached a height of 24,600 feet without mountain sickness developing in any of the climbing party. To a person who has not been acclimated to such altitudes, a stay of any length of time at 27,000 feet means certain death within a short time. Persons in bad physical condition and who are not acclimated may develop serious symptoms at heights above 12,000 feet. The physiologist Haldane believes that acclimatization means the developing of the ability of the lung tissue to provide oxygen for the blood, a process which it would not be called on to conduct ordinarily.

### Nobel Prize in Medicine

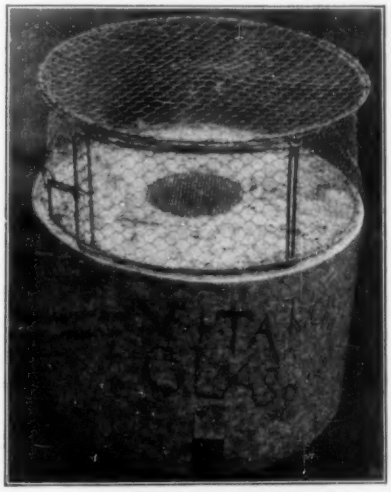
RECENT reports indicate that the Nobel prize in medicine for 1927 has been awarded to Dr. Julius von Wagner-Jauregg of Vienna for his work on the malaria treatment of general paralysis of the insane, a method which has been discussed at various times in these columns. General paralysis of the insane is caused by the organism that produces syphilis. Apparently it is unable to exist satisfactorily in the body in the presence of high fever or in the presence of other conditions that are brought about when malaria develops. The malaria once developed may, of course, be controlled by the administration of quinine, which has a specific effect on the malarial organism.

Since Prof. Wagner-Jauregg first announced his views, other investigators have apparently duplicated the clinical results by the injection of organisms of a nature similar to that of the malarial organism, and indeed by the injection of non-specific protein substances which produce a shock reaction that results in high fever and the throwing of white blood cells into the blood.

### The Effects of Lightning Stroke

DEATH by lightning stroke presents many unusual phenomena. Sometimes little change is found in the body, except an occasional burned spot at the point at which the electricity entered. Sometimes there are more or less elaborate markings of the skin with fine, irregular, zigzag lines and feathery tracings which the superstitious have viewed with awe as being a picture of the lightning. If the stroke is sufficiently severe, there may be ruptured blood vessels or broken organs in the abdomen. Death from electric shock may, however, frequently occur without any important changes that will be visible to the pathologist who makes the post-mortem examination. For this reason, public service corporations dealing with electricity demand that artificial respiration be kept up for many hours after the person may apparently be dead, because sometimes the organs will resume their functions after a long lapse of time.

Recently a Scandinavian physician has asserted that death from electric



THE RAT CAGE

*The necessary warmth is supplied to the rats through a hole in the center of the galvanized casing.* *See other illustration below*

shock is never certain and that many persons who are electrocuted in the electric chair are not really dead and may be revived by prolonged artificial respiration. Certainly the subject is one which seems to demand much more extensive investigation than has yet been given to it.

### The Chinese System of Paying Physicians

AMONG current superstitions concerning medicine is the strange notion that in China the physicians are paid to keep people well and not paid when the people become sick. Apparently this belief is so well founded that Lord Cozens-Hardy in a recent discussion before the insurance companies of Great Britain urged the adoption of this system for that country. The idea, of course, is not a new one and the practice of preventive medicine is becoming more and more a part of the regular occupation of every physician in advanced countries.

Some years ago, *The Journal of the American Medical Association* determined to find out once and for all what basis might exist for the belief that the Chinese regularly used the system referred to. An investigation made among educated Chinese, an inquiry to the Chinese embassy in Washington, D. C., and to the Chinese consulate in Chicago, revealed the unanimous belief that such a system has not existed in China recently and probably never did exist.

# The Much Maligned Bat

## *These Ugly Creatures That Dart About in the Twilight are Our Friends and, in Most Cases, Harmless to Man*

By PAUL GRISWOLD HOWES

*Curator of Natural History, Bruce Museum, Bruce Park, Greenwich, Connecticut*

"BATS catch in your hair and you can not get them out; and besides this, they are swarming with vermin!" This absurd exclamation appears to sum up the whole bat situation for most of us. We have been brought up to think in this manner about so many very interesting and useful creatures that it is really too bad. These handed-down absurdities are a failing of the human race of another day, a day when men refused to observe things truthfully, and apparently made up their science as they went along. In so doing, they often turned their fellow men, as well as their children, to war against some of their most helpful neighbors, instead of conserving them and looking out for their future.

On the old travelers and naturalists, we may depend for little truth, for their journals about the sunny tropics and other far lands of promise are filled with accounts of horrible serpents, frightful diseases, and a thousand other terrible hazards, which, of course, did make good reading for more timid folk at home.

Let us study the bats for a while in their home and see what good little fellows most of them really are. To do this most successfully we should go to the warmer countries, for here the bats swarm in countless numbers. There is no cold season to send them scurrying into hibernation and they are at their best the whole year around.

The Island of Dominica, where the author spent several months studying these weird little creatures, is situated in the Leeward group of the West Indies, midway between Guadeloupe and Martinique. It is a high, rugged, and jungle-covered volcanic island, with a great annual rainfall, and an abundance of the insect and vegetable foods on which bats subsist. Here they have come from other islands and the mainland of South America, until there are great numbers of them all through the mountain forests, in buildings, and in deep, foul-smelling fissures and caves left by the great volcanic upheavals of the past.

Bats are very sociable animals, congregating in large numbers, sometimes reaching into the thousands. They give birth to their pink and naked young like other mammals, and feed them by nursing. A small colony of dusky bats that lived in the roof of the author's Dominican camp, possessed fur as soft and beautiful as seal. These particular animals also possessed regular tails like those of mice. Each evening at dusk, the colony would become restless, and much squeaking and chattering in that inimitable language of bats, would tell of the excitement and hunger felt by the whole outfit. After sleeping all day, their little stomachs would be gnawingly empty, and to them the dusk promised a big feast of insects.

**DOMINICAN BAT**

*Here we see the absurdity in saying "blind as a bat"—note beady eyes*

**YELLOW NATALIS**

*Rare Dominican bat enlarged to show grotesque face and sharp teeth*

All photographs by the author

**LEAF-NOSED FRUIT BAT**

*The "leaf" is a special sense organ and the barbed tongue is for rasping its fruit food*

**SPECIES: MOLOSSUS**

*The author had a family of these in his tent. This ugly bat is quite harmless despite its mean appearance and dog-like teeth*

**CAVE BAT**

*Head of a minute species which inhabits caves. This one has downy, ruffled fur and a fleshy appendage in his leathery ear*

After a time one would crawl to the crack in the roof through which they gained access to their roost. He would look about for a minute or two and then drop away into the jungle gloom on wings of absolute silence. In a little while the whole colony would be gone, only the females of the families returning before dawn to nurse their babies.

Many of these bats were examined closely and not one was infested with what we call vermin. Our dainty swallows and phoebes at home are filthy compared to bats. Bats do carry one form of parasite very commonly however, but it is in the form of a fly. This strange and tiny yellow insect is much flattened, expecially fitted to accompany the bat upon its wild aerial journeys. If it were of the usual fly outline, the wind would soon remove it from its host and so Nature has moulded it into a specialized fly! They cling to the bat's fur, two or three on each animal, and here they ride through all the thrills known to aviation, for there are no better or more erratic flyers in the world than the various species of bats.

It is a strange fact that a fly should successfully live with animals that are ravenous insect feeders, but these little yellow ones appear to be immune. There are many species of these bat-flies and one may almost identify the bat or the fly if the name of host or parasite be known, so particular are the flies to select certain species of bats to live upon.

MOST of the smaller bats are insect feeders. They catch and devour countless numbers of flying things such as flies, mosquitoes, beetles, and moths, and are therefore of great benefit to man. Not only do these insectivorous varieties help destroy our worst pests, but in addition, in the tropics where they congregate in vast numbers, they supply one of the richest of all fertilizers. Insects are very high in nitrogen, and the bat guano collected by the natives in great quantities, is so strong that it is necessary to mix it with large quantities of other substances before it may be used with safety for crops. Fertilizers which are too strong can do more harm than good when not mixed properly with other ingredients.

FLYING FOXES

*Sometimes measuring two feet from wing-tip to wing-tip, they sleep head downwards*

It is a common sight in the West Indies and in other countries to see pack trains of donkeys coming from the bat caves, loaded down with the valuable guano.

BATS are in a class by themselves. They are not flying mice as often supposed, and they are the only flying mammals. How they evolved no one can say, but it is marvelous how the bones of the fore limbs have lengthened out into long and delicate supports for the thin membrane of the wings. It is as though our fingers were 10 feet long with thin webbing grown between them. During the day, or whenever the bats are at rest, the wings are folded up and they often hang head down while asleep. On the elbow of each wing is a powerful hook which is used in clinging and climbing, or in moving over the walls or limbs of their secluded aerial retreats.

The expressions of bats are grotesque and sometimes frightful, and it is this fact, perhaps, that causes the disgust which they inspire in most people. They are equipped with various special sense organs, such as glands and hairs, and possess strange, fleshy appendages within the ears, called the antitragus, which are probably for some special sense also. They are anything but blind, and many of them can fly about through the branches without the slightest trouble. See illustrations on opposite page.

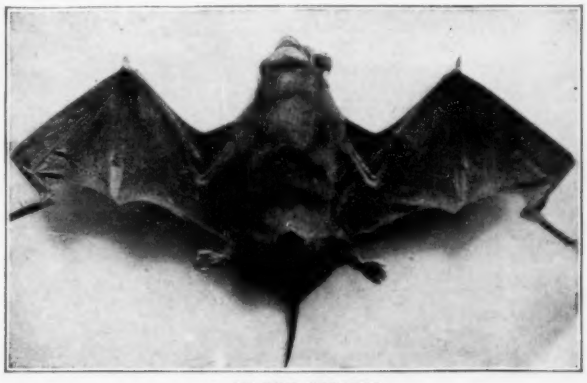
Some of the bats are fruit-eaters and of course these do much damage at times, but they do not appear to occur in such vast numbers. They are often equipped with long barbed tongues as shown in one of the photographs and have fleshy, leaf-like objects protruding from the nose. Some grow to great size and at certain times in Dominica, huge red-furred creatures with a wing spread of over two feet come down from remote mountain caves to feast on newly ripened fruits. They look like flying foxes and cause great terror among the natives, but are really as harmless as their smaller fruit and insect-eating cousins.

In South America we find the true vampires, which suck the blood of cattle and, occasionally, of humans. These are disagreeable of course, but let us remember that all our northern bats, and the vast majority of tropical species, comprise a huge standing army working for man, their greatest persecutor, by eating untold millions of insect pests.

¶ *Sharks—to most of us, the very name serves to conjure up unpleasant visions. But when you read the article by Prof. David Starr Jordan that will appear in a future issue, you will find that there are two sides to the shark question.*

HOW THEY SLEEP

*Some bats hang by their toes like this when sleeping but most of them fold their wings tightly against the body. The one shown in this illustration chose to sleep with his wings spread like a bellows*



A CLOSE STUDY

*This strange sooty-colored specimen had the soft silken fur of a seal and a tail similar to that of a mouse. This view gives a good idea of the bony structure of the wings, and the "arms" which support them*

# Oil Tanks Moved by Floating

## *Unique Method Employed to Overcome Difficulties and Prevent Necessity of Demolition*

WHEN plans were made by the Southern California Edison Company to construct the first of a series of eight new 125,000 horsepower steam units immediately adjacent to its present steam plant at Long Beach, California, it was discovered that the proposed site was occupied by two 30,000-barrel reserve oil tanks, surrounded by concrete walls eight feet in height and more than 1400 feet in total length.

When the problem first presented itself, it seemed as though there could be but one solution, and that to completely demolish the walls, then to jack up the tanks and haul them across the intervening distance on skids, in some such fashion as would be adopted in the moving of a residence. This method it was recognized might place such strain upon the riveted steel plates of which the tanks were fabricated, as to do serious and permanent damage to them. It therefore occurred to the engineers to attempt to create an artificial pond and to float the two tanks across this pond to their new location.

WHEN the question of breaking up the concrete wall was considered, the problem of the removal of the resulting debris loomed large, and it was finally determined to attempt to salvage the wall entirely and use it around the tanks after they had been removed and were in position.

To carry out this idea, a standard railroad track was laid around all four sides of the wall. The wall, which extended seven feet above the ground and four feet down into the ground, including a base four feet wide and 18 inches thick, was cut into lengths of approximately 35 feet each. A trench was dug on both sides of the wall and with the aid of hydraulic jacks, these sections were hoisted into the air. Then the tracks were placed into position directly underneath this wall.

FLOATING IT DOWN

*Tank being pulled by small yard locomotive (not shown) across placid surface of pond*

The sections of the wall, weighing over 80 tons each, were then let down upon standard flat cars and hauled away to a siding, awaiting the moving of the tanks. When the wall had been entirely removed, an earth dike three feet in height, arranged to form a long narrow pond which took in both the old site of the tank and the projected site, was built around the first of the tanks. When this one had been floated down, the process was repeated for the second tank.

While the tanks would float in about nine inches of water, the unevenness of the ground made it advisable to make the pond almost three feet deep. Before attempting to float the tanks from their base, it was necessary to construct truss work inside of each of them to reinforce the bottom of each tank and to prevent the pressure of the water against it from causing it to be permanently warped out of shape.

THE tanks were actually moved across the surface of the pond with the aid of a small yard locomotive and cable. Some difficulty was experienced by the wind pressure on the sides of the tanks, but this was overcome by the use of hand lines and a crew of men along the banks of the pond. The entire job of moving these two tanks by this unique method was completed without serious mishap.

CUTTING AND LIFTING WALL SECTIONS

*Section of wall suspended prior to its removal to the new site of tanks. The hydraulic jacks used for lifting huge sections are shown*

PLACING WALL IN NEW LOCATION

*After tanks had been floated into place, the wall sections on flat cars were brought up, dropped into place, and firmly cemented*

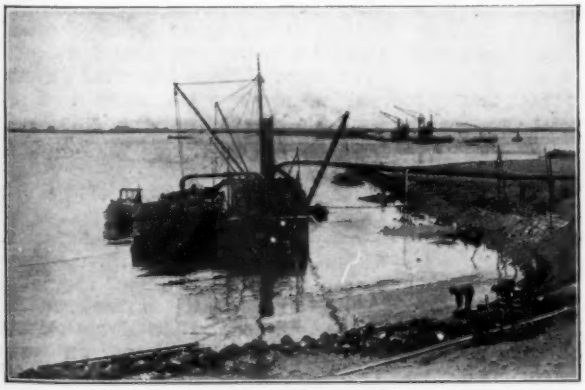
All Wide World Photographs.

**COMPLETED SECTION OF THE DIKE**

*Airplane view of the part of dike already constructed from the west coast of the island of Wieringen to the mainland. It will be recalled that the ex-Crown Prince of Germany resided on this island for several years after his exile*

# Filling In the Zuyder Zee

WITH the successful completion in the next 10 or 20 years of the gigantic engineering work now being carried out in the Zuyder Zee in Holland, that picturesque land of canals, dikes, and windmills will have lost one of its most famous features. Long familiar to the world in song and story—to such an extent that it has come to symbolize the Dutch—this "sea" is now being dammed up and filled with earth. The work, which started in 1925, consists in building a huge dike across a narrow part of the Zuyder Zee, so as to effectively shut out the waters of the North Sea. After the dike is completed, the lake thus formed will be filled in with dirt and the task of draining will be begun. This will add a territory of approximately 2000 square miles, as the cut-off portion of the Zee is about 80 miles long and 25 wide. In such a small country, this addition is well worth while. The dike will extend from the island of Wieringen to the town of Piaam on the eastern side of the Zee. A subsidiary dike has already been constructed from the west side of Wieringen to the mainland. Total length of the two sections of dike will be about 19 miles. While it is true that the land which will be added by this filling-in will be valuable, still we shall all feel that it has taken a bit of romance from the world. The photographs on this page give an idea of the magnitude of the work that is being carried on, the completion of which will add so much to the wealth of this kingdom.



**ON THE SHORT LINK**

*Constructing the dam from the island to the mainland. The dam itself is of stone, while the fill is made up of soil dredged from the sea*

**METHOD OF CONSTRUCTION**

*A dredge at work building up the dike on the completed side. The photograph shows that at present there is a strong flow through the Zee*

# Successful Inventors—XIV

## *Patients, Patents and Profits Sum Up the Career of This Inventor Whose Devices Aid In Rebuilding Human Bodies*

By MILTON WRIGHT

NO matter what a man's calling, constructive imagination, resulting in a patentable process or device in which the public sees some benefit, brings its reward.

To illustrate, consider the case of Jack Cooper, physical trainer extraordinary, who has brought the glow of health to the cheeks of all sorts and conditions of men from prize fighters to presidents, to say nothing of trimming the waistlines of all sorts of women from chorus girls to millionaire dowagers. How has he done it? By patentable inventions.

"Does inventing pay?" we asked him.

"Well," he replied, "a large part of the money I have made has resulted directly from inventions."

"How have inventions paid you—by outright sales of patents or by keeping the patent rights and selling the patented articles?"

"I've tried both methods. Which method to use, depends, I should say, upon the nature of the invention and the facilities you have."

"How did you start inventing?"

"My life work has been body-building. Even as a boy I was devising new methods of developing the human physique—methods that doctors had neglected. At first it was my own body I was interested in; later it was other people's bodies."

"I guess, Jack, we had better start at the beginning."

"All right, here goes. As a young man I was a professional pugilist and I fought in the prize ring from 1884 to 1892. Then, in one of my bouts, I broke my right hand. All things considered, I guess it was what you might call 'a lucky break.' I began training other fighters and opened a gymnasium up in Harlem. There were only three other gymnasiums in New York at that time.

"ONE night a man walked in and watched the boys being put through their paces. His wife was being elected president of a woman's organization meeting upstairs and he had to wait some place.

" 'Young man,' he said, after he had watched us for a while, 'you are doing a great work, but you are 25 years ahead of your time. You ought to study anatomy. Come and see me and talk it over.'

"After he left I looked at the card he had handed me. My visitor was Abraham Jacoby, one of the leading physicians of New York. The result of that visit was that Dr. Jacoby himself spent two evenings a week explaining to me the workings of the human body. This was the fundamental knowledge I needed to make devices for aiding human beings to function properly. Altogether I have gone through courses in anatomy and physiology five separate times.

" 'You now know how the human body works, both normally and when something is the matter with it,' Dr. Jacoby said to me after we had spent a whole winter together. 'Now go out and use your imagination in devising ways to aid the functioning of some parts of the body without imposing harmful stresses and strains on other parts.'

EXPERT IN HUMAN MACHINES

*Jack Cooper's success lies in combining his inventive ability with his intimate knowledge of the human body*

"And that is how I prepared for being an inventor."

"How did you come to make your first invention?"

"I was manager and track master at the Manhattan Bicycle Track from 1893 to 1899. A man would be carried from the track, completely exhausted, to a table for a rubdown. Then he would have to be lifted up while his supporter, or girdle, which every athlete wears, was taken off. This lifting him up was an extra strain which was none too good for him in his weakened condition. Why, thought I, would it not be possible to devise a supporter that could be taken off while the man was lying down?

"I made such an article—nothing complicated about it—just separate parts fastened together with snap fasteners that could be snapped apart in an instant. A manufacturer paid me 12,500 dollars for my patent."

"But how did you find the manufacturer?"

"I didn't. He found me. My invention made a hit with bicycle riders, jockeys and other athletes. They wanted it. Then, too, I made a little exhibit of it at sporting events. It does not take a manufacturer long to try to get hold of something which he sees the public wants. I received a lump sum for the sale of my patent outright.

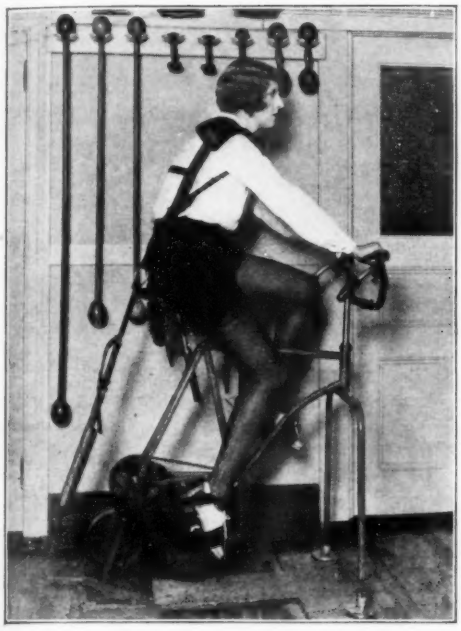
"Another invention I sold outright was a swivel for a punching bag. Under strenuous pounding in a gymnasium the rope holding a punching bag would last about two hours. I worked out a little brass swivel into which a few drops of oil could be poured. The rope, even with the most constant and severe treatment, would last for weeks. Gymnasiums all over the country wanted them. Individuals who had punching bags at home saw them in the gymnasiums and wanted their own bags equipped the same way. The field was limited, but from one athlete to another the demand spread remarkably fast. One day I walked into the office of one of the biggest manufacturers of sporting goods in the country, showed him the swivel and came away with a check for 2500 dollars for all my right, title and interest in my patent. I had spent about two weeks in time and 100 dollars in money on that invention.

"FROM time to time as the need would arise, I invented new devices for the benefit of the people I was helping in my gymnasium. Some of these I patented and some I did not. With some of these I profited directly and with some indirectly—that is, from the benefit to my patients."

"What has been your most profitable invention?"

"The 'reducycle'—a sort of sweating cabinet with a bicycle frame and pedals but no wheels, and an electric heater. Colonel Roosevelt, for whom I designed the thing, suggested the name.

"Back in 1917, the former President was a sick man. His disagreements with President Wilson, as well as the death of his son Quentin, had worried him into a condition where he had high blood pressure and insomnia. His medical advisers looked around for



**◂HORSES! HORSES!**

*Bicycle riding is good; it exercises your legs. Horseback riding is good, too; it exercises the muscles in the lower abdomen and back. The need for a contrivance which combined the best features of equestrianism and cycling was Cooper's opportunity for a worth-while invention. As you ride it, you get all the sensations of "posting" on a bridle path except the scenery and the danger of falling off*

**CLIMBING TO STARDOM ▸**

*Like many of Cooper's patients, the young lady at the right is an actress, recently "at liberty" but now under contract for a new show. Her weeks of idleness have stiffened her muscles. A bit of mountain-climbing is what she needs and the body-building specialist has a machine for the purpose. Climbing for a few sessions will enable her to dance as nimbly as ever*

someone to put him in shape. Out of 28 men considered, I was selected. At that time I had a health farm up in Connecticut.

"I got a big packing case, lined it with asbestos cloth and put in it an electric heater, a pan of water and an old bicycle with the wheels taken off. Over the open top I put an umbrella cover with a big hole cut in the middle. This was for the Colonel to put his head through.

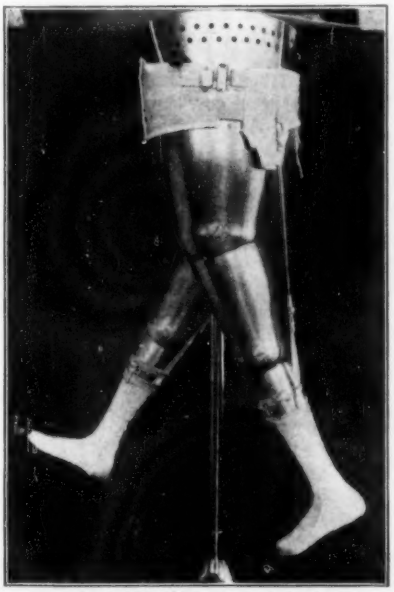
"Colonel Roosevelt climbed inside and started to pedal away. To get his mind off what he was doing, I got him talking about the Spanish War while I watched his condition closely. After 17½ minutes he was perspiring profusely, his pulse was normal and his blood pressure had gone down. He wanted to keep on but I wouldn't let him. That night he slept like a top for eight hours.

"THE heat-box with the bicycle frame in it was the backbone of his treatment in the ensuing weeks. Before he left my place his blood pressure had been reduced from 224 to 169, his waist had been slimmed from 49¾ inches to 44½ inches and his weight had dropped from 217½ pounds to 199 pounds. This was accomplished in 18 days.

" 'Jack, you have a wonderful thing in this invention of yours,' he said to me one day. 'There are a lot of people in this country who need it and you ought to make money out of it.'

"After I had applied for a patent I formed a corporation to put it over. A few rich men who had confidence in my physical-culture methods gave me their financial backing and we had several hundred reducycles made. The method that had brought Theodore Roosevelt back to health had received considerable publicity and it was not hard to get gymnasiums and beauty parlors to buy reducycle cabinets. A few advertising circulars did the trick.

"Then it occurred to me that there was a still wider market. I appointed a large number of managers of gymnasiums and beauty parlors as my agents and allowed them a liberal commission on sales they would make to people for use of the reducycle in their own homes. At first the physical-culture and beauty specalists protested that every time they sold a reducycle it would mean the purchaser would cease being a patient. I pointed out, however, that for every man with one of them in his home there would be a number of his friends who would be induced to go to the gymnasiums or beauty parlors for treatments."



**AN INVENTION ON DISPLAY**

*Crowds gather to watch mechanical legs demonstrate Cooper's latest invention—the leg and foot builder illustrated above*

"How much money have you made out of the reducycle?"

"ABOUT 65,000 dollars directly from sales. You might add to that the money I have made by giving treatments with it. After my financial backers had made 20 percent on their money they pulled out, leaving me the business. The patent has about six years left to run and I expect sales will continue."

"Are you devoting all your time to promoting the reducycle?"

"Certainly not. My mission in life is body-building. Inventions are only a means to that end. Some persons who come to my place would be benefited by one thing, others by something else. Over against that wall you see an invention which gives you all the sensations and benefits of mountain climbing; in this corner you see a mechanical horse on which you post, just the same as if you were riding on the bridle path in the park; over there is a muscle-stretching device.

"Now I have perfected the best invention of the lot—a leg and foot builder calculated to cure permanently fallen arches or any trouble in the hips, legs or feet. Its efficiency is proven already and its commercial success is assured."

"Why is its commercial success assured?"

"Because I know from experience that if you give the public something it needs, you need not worry about your profits."

STUFFING

*Frankfurters are made in the usual way by stuffing the new viscose casings on the same machine as that now used for animal intestines*

SKINNING

*After the frankfurters are stuffed into the viscose casings, they are then smoke-cured and the temporary skins removed by hand peeling*

# "Hot Dogs" de Luxe

## *With Skins Eliminated By Chemical Science, the Plebeian "Frank" Comes Into Its Own*

By D. H. KILLEFFER
*Associate Editor,* Industrial and Engineering Chemistry

"HOT dogs in rayon wrappers" sounds more like characters from a comic strip than subjects of serious concern to earnest sausage makers, but in these fast-moving modern days, the stranger a thing is, the more likely it is to be true. Not only are such things highly practical and economical, but the stir caused by temporarily dressing sausages in silk and then sending them nude to the market is making itself felt in all kinds of ways in a most remarkable manner. One may easily see in this situation the modern sword of Damocles suspended over the head of industry by a slender filament of brain power whose ability to prevent the sword's fall depends entirely upon the constant reenforcement of that filament through research.

It is a far cry from mulberry leaves feeding Chinese worms, to Canadian spruce logs passing into American chemical factories, but no longer is it strange to relate that both ultimately become silk stockings. Is it then so strange that the spruce tree or the cotton fiber, which have long supplied a substitute for the material of a silk worm's cocoon, should, by a like change, give us the equivalent of an animal's intestine? On the face of it the answer to that question should have to be "No," but much to their sorrow, such a train of reasoning did not occur to a very well known firm of sausage-casing manufacturers until someone else had beaten them to it. Of course, they were *practical* (how dismally that word is misused!) sausage men and they had no time nor money to devote to finely spun theories about silk worms, actual or artificial. This quite logically gave the other fellow a real chance of a lifetime.

Because sausage always had been stuffed into intestines no longer useful when their animal owners became mutton or pork, these practical sausage casing men were smugly satisfied to believe that sausages always would be made that way. Whereupon they laughed loudly and long at the idea of spending one's profits and time chasing a will o' the wisp and signed a long-term contract for several years' supply of raw intestines. Probably the Fates, if those three ladies are still busy with human affairs, laughed over that contract, for it was merely a matter of a few weeks afterward when a really proper casing for sausages regarded the long search of the ridiculed one. Hardly had the seemingly endless procession of intestines begun to arrive at the selecting plants of the practical men when they found that already manufactured casings were being preferred to their own.

WE have hinted above that these new sausage casings are like rayon, and to show just how they are alike, we must consider how each is made. The differences between a rayon filament and a cellulose casing for a sausage are very slight, except that one is a very thin rod and the other a thin, very flexible cylinder. The material from which the two are made is almost identical, but there are slight differences which make each a success for its particular purpose. Both start in life as rather pure cellulose in the form of paper pulp obtained by dissolving out the constituents of wood which are not cellulose or of the very short fibers left on the cotton-seed after the valuable cotton has been taken off in the gin. Either of these raw materials may be used, or mixtures of them, but each has its peculiar characteristics which influence the final product and receives the treatment necessary, to convert them into either rayon or sausage casing.

The first step in the process consists of converting these cellulose fibers into a sticky liquid which can be easily molded or otherwise shaped into the desired form. To do this, the cellulose is first treated with strong caustic soda solution to mercerize it; that is to say, to convert it into soda cellulose. In this form its appearance is quite unchanged, but it has undergone a complete alteration of its chemical characteristics. While before it was unaffected by many chemical reagents, it can now be converted to a honey-like liquid by the addition of carbon bisulfide and water. The liquid thus obtained, viscose or cellulose xanthate, is easily reconverted into the original cellulose, and in the meantime it can be shaped into any desired form.

One of its principal characteristics is its so-called viscosity, its resistance to flow, which varies greatly, depending upon the exact way in which it is made and the length of time it is allowed to stand after being made before it goes farther in the process. Each material to be made and each particular process of treatment requires a solution of a different viscosity and the entire success or failure of any project based upon viscose depends upon one's ability to secure exactly the right viscosity in this solution.

To make a silk-like fiber from this

sticky liquid requires the highest refinement of mechanical skill in the building of the spinning machine. The accuracy with which its parts must work together to produce a fine lustrous filament is quite comparable with that of a fine timepiece. The function of this machine is to squirt the viscose solution through a very fine orifice into the coagulating bath at the exact rate at which the finished filament is wound up on a reel. [See page 112, August, 1926, issue of SCIENTIFIC AMERICAN. Editor.]

IT is necessary that the coagulating bath, containing sulfuric acid, harden the filament while it is slightly stretched, and the speed of the reel and that of the pump supplying the viscose solution must be so carefully regulated with respect to each other that the very tiny filaments are not broken before they are sufficiently hardened to stand the pull upon them which keeps them straight. When these filaments have been taken out of the coagulating bath, they consist of practically the pure cellulose from which the operation started. This has a difference of form which makes it more valuable and although it is actually cotton or wood, it is much more like silk.

A very interesting and very important part of the spinning machine is the so-called spinneret that gives the filaments their shape just at the time they are being changed from viscose back to cellulose. Because the coagulating bath is highly corrosive on account of the acid it contains, this little nozzle, consisting of several fine

Photographs Courtesy Viking Corp.

MOUNTING CASINGS

*For shipping, the casings are cut into lengths and "crinkled" by hand on dowel pins*

and very precisely round holes, must be made of platinum. Thus, the modern bride's costume may be made by using the same material as that of her wedding ring. This little spinneret is particularly interesting because it is here, in this comparatively small part of the whole equipment required, that the only real difference is found between a machine for turning out silk and one for imitating animal intestines. Where the silk-making machine possesses a spinneret with tiny round holes, the sausage skins take their shape from dies very similar to those used in forming such things as lead pipe. Of course, it is not the same kind of an affair, as the thickness of the sausage skins must be much less than that of any lead pipe. It is also different from the silk machine because an arrangement must be made to coagulate the inside of the skin by squirting acid solution into it at the same time its outside comes in contact with the solution in the coagulating bath, thus assuring perfect consistency.

The operation is not quite as simple as it sounds nor is it one at which anyone may expect to succeed on a moment's notice, but when properly carried out it yields a very, very thin seamless tube of cellulose. The diameter and thickness of the tubes can be varied almost at will by changes in the machine and there seems to be no practical limit to their length. These things are exactly what the sausage maker has wanted. The intestines of hogs and sheep vary in length, in thickness, in diameter and in strength, and it is only by very careful grading of the skins before use and careful watching of them while being stuffed that one can be sure the sausages will come out with reasonable uniformity and certainty. By providing a skin which is uniform in every way and quite strong, this new process allows sausage stuffing machines to run faster and longer and insures an absolutely uniform product at all times.

NOTHING really worth while ever came without effort and so we may trace the history of cellulose sausage casings back for 15 years or more to some early unsuccessful attempts to make them in the earlier days of rayon manufacture. We have not had a real rayon industry in this country very long and during its short life a vast fund of information has been accumulated about the subtle peculiarities of viscose solutions for silk manufacture. It is important to note that in spite of their apparent similarities as outlined above there is still a vast difference in detail between a silk stocking and a synthetic sausage skin, so that it was really too much to expect that all the problems of the new venture would be solved by an existing industry. Certainly they were not, and so it was that the "practical" men got their excuse for the first laugh while their thoughtful competitor spent large sums of money and several years learning how to make better intestines than an animal could.

The thing that he finally got seems to be far better than anything yet imagined for it is a simple matter to do everything with the new casing one could possibly do with the old and some other things besides. Links can be easily made, and curing takes place quite as readily through cellulose as through other casings. The cellulose is quite tasteless, and while positive digestibility in the human system has not been proved for it, it is certainly no

CASING DRIER

*The viscose tubes, after being spun, are run through special chemical baths and dried*

less so than bran, so popular in modern dietaries, and very probably it is digested quite as well as intestines are. Also, because they contain no protein, cellulose casings do not putrefy under any circumstances. They seem to be quite difficult for bacteria to assimilate.

Strangest of all the valuable properties of the silken "hot dog" casings is the ease with which they may be removed after the dogs have been shaped and smoked. The manufacture of many varieties of sausages, such as frankfurters, wienerwurst, and others, includes processes of partial cooking and smoking after the links have been formed. Now, because intestinal casings are really very similar to the meat they contain, these operations change the casing in much the same way that the meat is altered and a very intimate and clinging attachment is created between the two.

THAT is the reason it is so difficult to pull off the skin of smoked sausage. With cellulose casings the situation is decidedly different. Cellulose is quite unaffected by cooking or smoking and in the end it may be readily removed, leaving the sausage in the regular sausage shape but without a skin. The preparatory operations produce a bond between the meat particles which renders the skin needless and now one can buy skinless sausages. In other words, the much ridiculed search for a perfect sausage skin led directly to one that is now making skins on sausages quite as obsolete as hoop skirts or high-wheeled bicycles of by-gone days.

# Weighing With Radio

## *The Versatile Vacuum Tube Assumes the Role of Micrometer Caliper and Scale*

By JAMES MILLEN

HAD there been rubber and paper mills in the times depicted in Arabian Nights, Aladdin might have rubbed his magic lantern and ordered the three genii to see that the sheets of rubber, paper, celluloid, oilcloth, roofing and whatever else he was interested in, were

ALBERT ALLEN

*Inventor of the precision oscillator for the measurement and weighing of materials during the process of manufacture*

rolled by the mile in strips of absolute uniformity.

Today, the modern lantern of Aladdin does not even require rubbing in order to guard over the uniformity of the strip material manufactured in many large mills.

This modern guiding light need merely have its arms stretched over the passing material in order to record, without coming into contact with the material, every minute variation in weight. Further than that, it can, by means of suitable relays, be made to actually operate the control equipment of the factory so as to produce a material of unvarying uniformity.

Albert Allen, the inventor and perfector of this modern lamp of Aladdin once worked in the paper mills at Bangor, Maine. There he would watch one of his fellow workers occasionally tear a piece of new paper from the edge of the long moving strip. This small sample was then measured and weighed, so that the actual weight per unit area could be determined. If the sample indicated the weight to be high or low, the machines would be adjusted to produce paper of the proper weight.

While watching this process one day, Allen realized how fine it would be to have some kind of a reliable device which would instantly indicate the weight per unit area of the moving stock at all times.

But he did not spend all his time in the paper mills. He was an enthusiastic radio fan, and spent many an evening experimenting with different sets. On one such occasion, he inserted a piece of paper between the plates of a variable condenser in his receiver. Immediately the station he was listening to faded out and another took its place. Being an electrical engineer, as well as a radio fan, it was not long before Allen knew just the reason for this phenomenon. Paper has a much higher dielectric constant than air, and consequently, inserting the piece of paper between the plates of his condenser had increased the capacity of the condenser sufficiently to tune in a station transmitting on a higher wavelength.

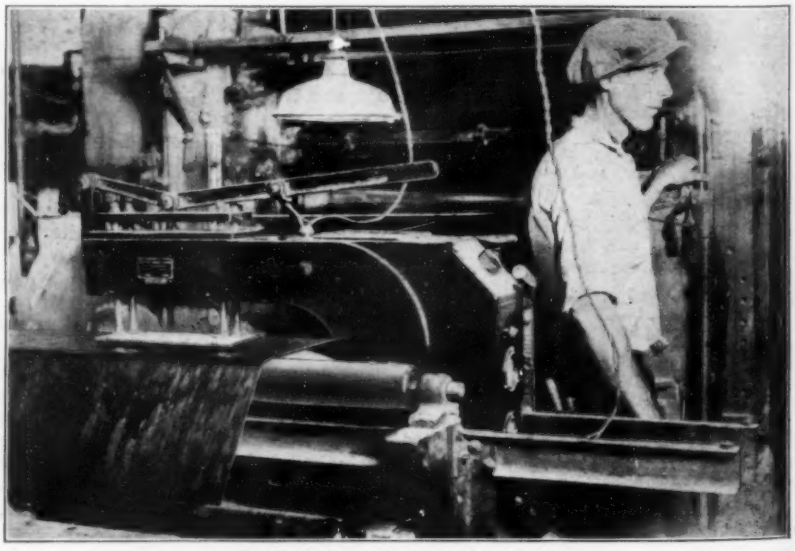
Further experiment showed that with a regenerative receiver tuned by the zero-beat method, very slight variations in the quantity of paper between the condenser plates would have a marked effect upon the tuning of the set.

TO shorten a rather long, but interesting story, Albert Allen spent several years in Cambridge, Massachusetts, at the laboratories at Harvard University converting his ideas into the finished commercial device shown in Figure 1.

The fundamental principle upon which the weightmeter depends for its operation is quite simple. Even the commercial form of weightmeter is also quite simple, and compact. In fact, from a commercial standpoint, such simplicity is essential, as the machines must, in the first place, be installed in an already existing mill without interfering with production—many plants operating their machines on a full 24-hour schedule—and in the second place, they must be nearly fool proof. These reasons, then, were just what required two years of research, both in the laboratory and in connection with experimental installations in the Bangor paper mills of the Eastern Manufacturing Company.

MANY different variations of the original idea have been tried. Some proved eminently satisfactory and were incorporated in the final model. Still more, in the course of time, showed their weak spots and were discarded. And now, as a result, is the instrument shown.

Primarily it consists of an oscillator and a tuned resonant circuit in which is located an indicating and a recording thermo-ammeter. This resonant circuit may be tuned by altering the



THE "WEIGHMETER" IN USE

Figure 1: *As the strip of rubber passes over the roller and under the metal plate, any variation in the thickness or weight of the product is instantly recorded. Defects are then remedied*

capacity of either of two condensers. One of these is the precision instrument shown in Figure 2 and whose function is to bring the tuned circuit into resonance with the oscillator when weighing material of widely varying dielectric constant, and the other is the large fixed condenser shown at the ends of the arms of the instrument in Figure 3. Between the plates of the fixed condenser pass the strip of material to be weighed. Any variation in the weight of the material between the plates of the fixed precision condenser at any time will result in a variation of its electro-static capacitance and consequently of the natural period of the tuned circuit. Thus the value of the radio-frequency current flowing through the meter will be altered.

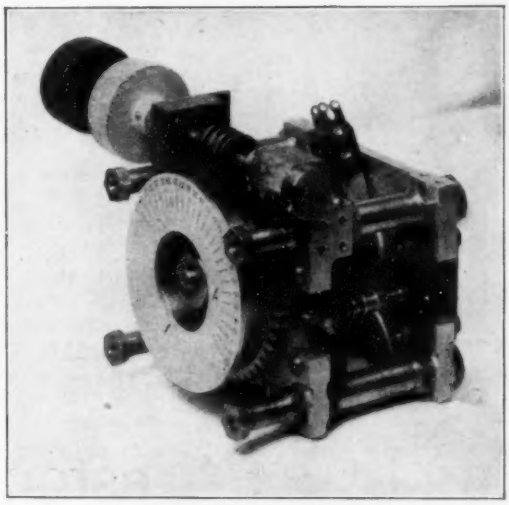
IF a strip of material, paper for example, is passing between the plates of the fixed condenser, and the precision condenser is set to bring the tuned circuit to a point just off the resonance peak, then any variation in capacity of the fixed condenser as a result of a variation in weight—and consequently of the dielectric constant—of the paper passing between its plates, will result in a change of oscillatory current. The meter needle then will swing away from its center position in a direction dependent upon whether there is an increase or decrease in weight of the moving material.

From such an explanation it may seem that the development of the device, once the fundamental idea was arrived at, was not exceedingly difficult. Such, however, is far from the case. Consider the effect of temperature for example. The early models were light devices made of steel and brass. Any change in temperature of the room or of the instrument itself as a result of the passing of a hot stock, such as rubber, between its plates, immediately caused the metal parts to expand slowly, resulting in a gradual change in the condenser capacity. This change would be recorded as a change in weight of the material being manufactured and the control operator would naturally change the adjustment of his calenders, under the impression that he was maintaining the weight of his product at the desired value.

The final result was that after several hours' or even a day's run it would be found that the stock was much over or under weight, as the case might be. Such errors were difficult to detect at first because of the gradual manner in which they occurred. The first step toward the correction of such temperature errors was the development of a compensating thermo-static condenser.

SUCH a solution, however, soon was found to be entirely too complicated for commercial use. The final solution was to change the construction of the condenser, employing a massive cast-iron frame with special invar steel supporting columns for the condenser plates. By properly arranging the cast iron and invar parts, the temperature changes of the condenser could be made to have no appreciable effect upon its capacitance.

Still another difficulty encountered in the first commercial installation was the tremendous variations in line voltages at some of the mills. In fact, this variation might be as much as 30 volts or so in some instances, which was entirely too great to be compensated for by the ordinary ballast means. The final solution was to so design the equipment as to make it entirely independent of line voltage variations.



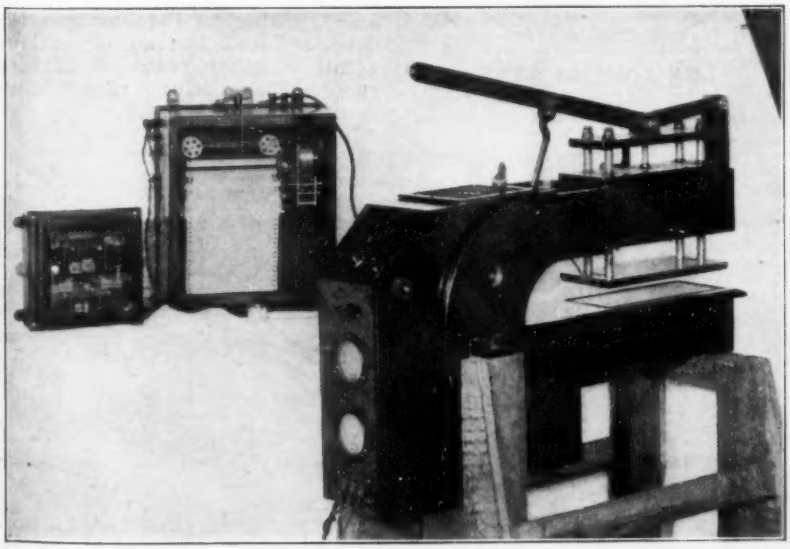
THE CONTROL CONDENSER

FIGURE 2: *One of the precision types of variable condensers used in the weighmeters for tuning the oscillator circuit to resonance. Vernier control is used*

While the weighmeter was found to be of value to the paper mills for controlling the weight of the paper, a still more important use for it was soon developed. In the making of paper, the moisture content is a very important factor, especially to the printing trade. It was found that a cellulose acetate ribbon stretched across the surface of the moving strip of paper, but not quite touching it, would be extremely sensitive to changes in the moisture contained in the passing paper. Using this cellulose ribbon to change the capacity of a fixed condenser, the moisture content could be determined quickly.

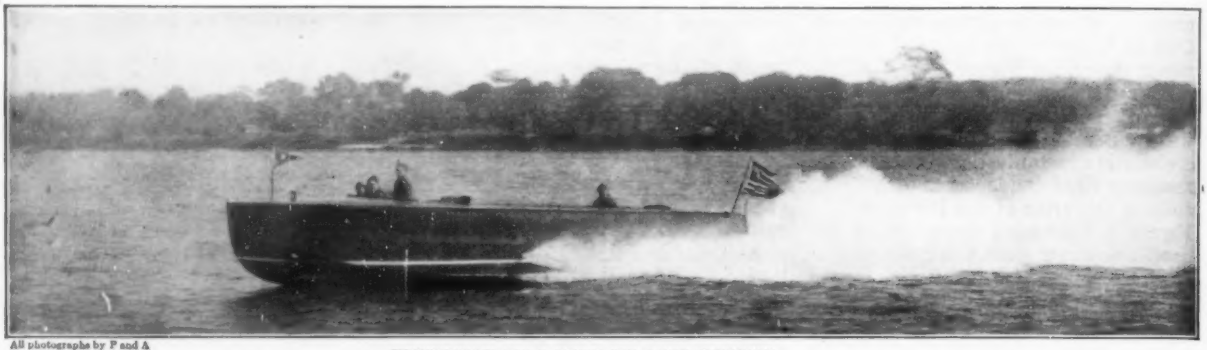
THE weighmeter used in this manner became known as a precision hygrometer. There was incorporated in it a system of relays by means of which it was possible to control the flow of steam to the pipes that dry the paper. Thus it became possible to automatically maintain the moisture content of the paper at the desired point.

The case of the oscillator of the weighmeter, and its various partitions are made of cast aluminum, which in addition to being a durable protective case for the instruments within, also serves as a shield to prevent undesirable electro-static and electro-magnetic inter-action between the different weightmeters located in the same mill.



IN ITS COMPLETE FORM

FIGURE 3: *In the foreground is the weighmeter oscillator and in the background is a recording gage and relays. Variations of the product being manufactured are recorded on the graph*



All photographs by P and A

SPEEDING IN LONG ISLAND SOUND

*Test boat, Fantail, designed and built for the purpose of trying out Danish inventor's device, shows a burst of speed near New York City. Note particularly how nearly on an even keel it rides. It is said to have perfect balance and to ride smoothly on rough water*

# Faster Motor Boats

## *Tests Show That New Invention, Attached to Motor Boat, Gives Greater Speed*

By F. D. McHUGH

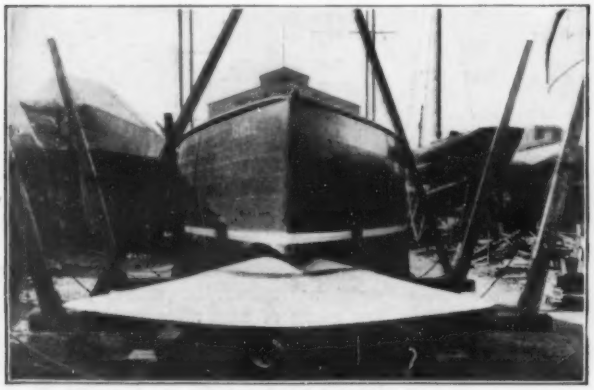
THE world's speed record for motor boats is 80.56 miles an hour. This was attained only by crowding the record-holder with four 450 horsepower engines and eliminating all load except two persons. Other boats capable of carrying a number of passengers have hitherto been able to make only 45 to 50 miles an hour.

A Danish inventor, Johannes Plumm, has recently perfected in New York a device resembling the tail of a whale which, when attached under the stern of a power boat, gives a great increase of speed while carrying a heavy load. In an official test of the *Fantail*, the boat designed and built for the inventor by his backer, Mr. C. E. Proctor of New York, a speed of 64 miles an hour was made while carrying a load of two tons, the engine used having only 500 horsepower. The boat made practically the same speed in a later test with 24 passengers. The *Fantail* is pointed both bow and stern, is 36 feet long and has a nine-foot beam.

LIKE A WHALE'S TAIL

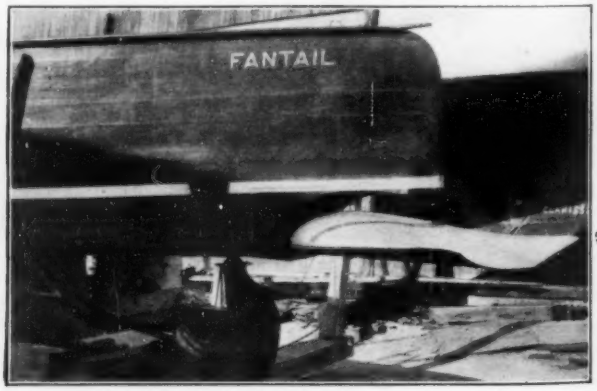
*The tail, looking down from above, showing its odd shape and pointed stern of the boat*

The "tail" is hollow and constructed of aluminum. It swings freely on a vertical axis. When the boat is at rest or just gaining speed, the buoyancy of the tail thrusts it up against a small roller, a metal track being provided on the tail to prevent damage. A boat with this attachment starts as an ordinary displacement boat, but after reaching 20 miles an hour, the tail is depressed by a vertical piston against which 100 pounds air pressure is exerted. This pressure is supplied by a simple air pump. On gaining speed, the boat skates over the water, theoretically resting on the bow and the depressed tail instead of pushing uphill as other boats do at high speed. The propeller is more efficient as it pushes horizontally.



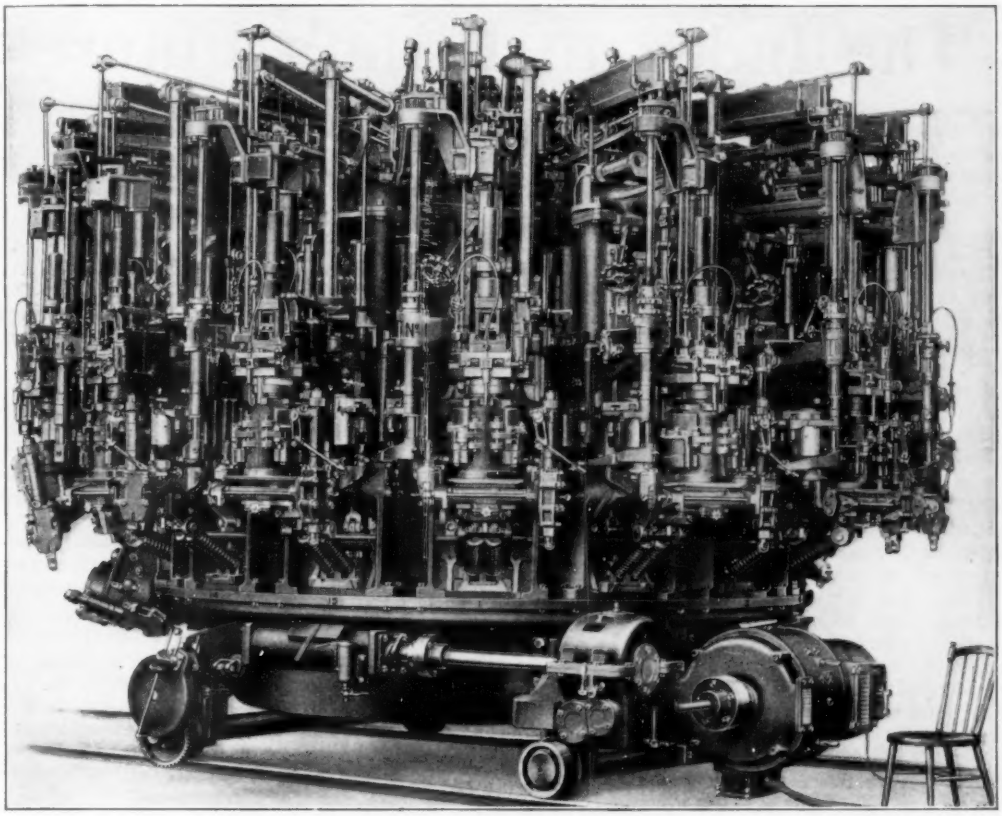
STERN VIEW

*The aluminum tail gives a hydroplane effect to the speeding boat, lifting the stern so that the boat skims along on a nearly level keel*



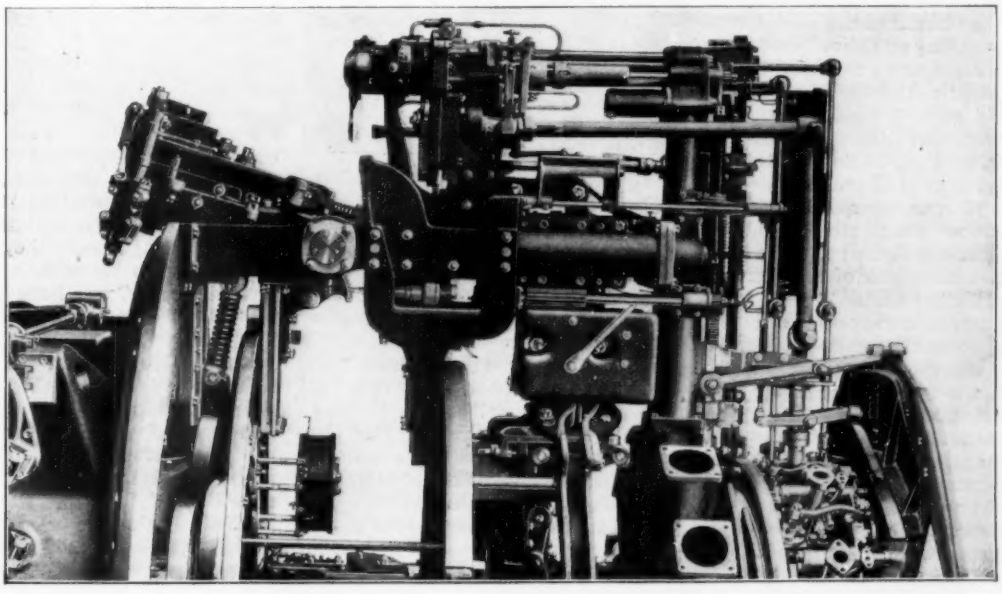

SIDE VIEW

*Tail is attached by a vertical axis bearing in the step-cut under the stern. Tail, when not depressed, "rides" up against small roller*



# Machine Makes Million Bottles a Week

THE new British bottle-blowing machine pictured on this page is entirely automatic in operation; it is 17 feet in diameter, 15 feet high; and the rotating part weighs 40 tons. It consists of 15 units, each a separate bottle-making machine, which rotate around a central column, being driven by a 15 horsepower motor. As the circle rotates and each unit passes the glass pot, the unit takes up enough molten glass for one bottle, which is completed in one revolution when single molds are used. Its speed can be varied from one and one half to six revolutions per minute. At six revolutions with single molds, 5400 bottles can be made in an hour; with dual or triple molds the output is correspondingly greater. Glass bottles of 15 different shapes and 10 different capacities can be blown simultaneously by this machine which is capable of making any size from two and one half to 16 inches in diameter. The photograph at the bottom of this page, showing one unit, should be viewed from the left.



# The Index to Radio's Future

## *Why the Public Should Not Consider Light-socket Receiving Sets As Premature*

By ORRIN E. DUNLAP, Jr.

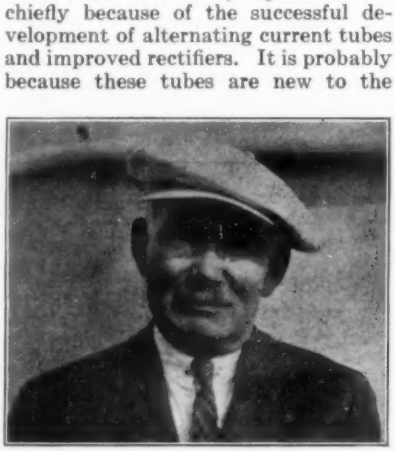
RADIO research engineers consider the vacuum tube as a golden opportunity through which advances can be made in both transmission and reception of Hertzian waves. The introduction of a new vacuum tube is generally looked upon as the vanguard of an improvement in receiver design. Tubes are the index of the future. Coils, condensers, and transformers are fairly well developed and standardized like the umbrella, but the mystic vacuum tube is expected to disclose many secrets of radio. The day is likely to arrive ere long, when a single tube adaptable to both alternating or direct current will do the work of six or eight present-day detectors and amplifiers. Then the cabinets will be small compared with some sets now in use.

VACUUM tubes do not contain a perfect vacuum. The ordinary detector is estimated to hold about thirteen trillion molecules of air. An absolutely perfect vacuum has never been produced. In the highest vacuum thus far attained, less than one ten-billionth of the air originally in the glass bulb remained after the exhaust pump had done its best work. In fact the most perfect vacuum made by man is said to have contained enough molecules of air so that every person on the face of the earth could have 80 of the tiny air particles before the bulb would be entirely empty! One engineer has visualized this in a different way by calling attention to the fact that the molecules in a cubic inch of air, if enlarged to the size of a grain of sand, would make a beach one thousand feet wide and 10 feet deep extending from New York to San Francisco. After exhaustion to the highest degree possible with modern apparatus, it is estimated that there still would be enough molecules of air per cubic inch to form a double line of sand grains across the United States.

The electrons, tiny specks of negative electricity, so small that even the most powerful microscope cannot detect them, give the vacuum tube its ability to promote progress in radio. One scientist estimates that if a drop of water, which includes a vast number of electrons, because of the hydrogen and oxygen within it, was magnified to the size of the earth, each electron magnified in proportion would be about as large as a grain of sand.

It was not long ago that a prominent radio engineer was asked in what field of the science he thought there would be the greatest opportunity for a young man in research, and he answered, "Tell him to learn everything he can about the vacuum tube; and warn him to keep his eyes and ears ever on the alert while in its presence. It has untold possibilities. Through revelations of the vacuum tube, broadcasting will become much more efficient and simplified. One tube in time will do all that nine tubes accomplish in receiving sets today."

The alternating-current tube is now the center of attraction. Several years ago many voiced the opinion that it would be impossible to operate a vacuum-tube detector in connection with the house-lighting circuit without a hum. But it has been done and done successfully. Thirty percent of the new models introduced for the 1927-28 season are electrically operated and chiefly because of the successful development of alternating current tubes and improved rectifiers. It is probably because these tubes are new to the



DR. LEE DE FOREST

*To Dr. de Forest must go the credit for inventing the three-element vacuum tube, the great development of which has made possible today's broadcasting systems*

radio public that some desirous acquiring an electrified receiving set have asked, "Are the new electrical outfits reliable? Will the new tubes stand up in service as well as the battery-operated tubes?"

The answer is, "Yes." The electrical instruments and tubes are thoroughly dependable if they are made by a manufacturer of high integrity. This type of tube may be new to the public, but radio engineers have been familiar with it for a long time and were absolutely certain of its ability to perform before they released it for practical use. Reliable companies would not risk their reputation by prematurely releasing a tube; no matter how great might be the public demand. No one who buys a good alternating-current set today need be afraid that it will burn out quickly.

The fear that the tubes will crumble in service seems to be based upon the idea that the filaments will not withstand the 110 volts of the house-lighting mains. However, the filaments are built heavier than in battery-operated tubes, and furthermore, a small transformer steps the alternating current down to a low voltage ranging from 1.75 to 15, while the majority of these tubes use about 2.5 volts. Thus the full voltage of the lighting lines is not applied directly to the filaments.

The plate voltage for the light-socket set is generally supplied through a separate filter and rectifier incorporated in the cabinet. The filter eliminates the hum caused by the alternating current, while the rectifier tube changes the alternating to pulsating direct current, which after passing through the filter is suitable for direct application to the plates without injury to the tube.

FOLLOWING the filter there is a voltage divider, comprising a series of condensers and resistances, which distributes the proper voltage to the various tubes. For example, the detector will not receive as high voltage as the audio amplifier or power stage. In a well designed receiver, the power-supply unit is completely shielded in a metallic compartment to minimize the magnetic effect between the power-circuit and other parts of the set.

"Although the new alternating current tubes are novel to the public," said Dr. Alfred N. Goldsmith, chief broadcast engineer, "they are well-known to the research and development engineers, who have been spending many years of painful effort to produce a thoroughly reliable and widely usable product. In fact, these tubes have been available for quite a time but have not been placed on the market until prolonged life tests were made on factory-built samples so that there would be no doubt as to the reliability of the tubes when used by the public, and produced on a necessarily large commercial scale. Furthermore, before these tubes were produced

commercially, the numerous problems of their successful use in practical receiving sets were solved so that the radio industry could produce socket-power operated receivers conveniently utilizing these tubes.

"Alternating-current tubes are highly specialized," said Dr. Goldsmith. "One type utilizes raw alternating current for heating its filament, and this tube is employed only for certain functions in the circuit where it acts most efficiently. Another type having a heater element is also employed only in those receiving-set sockets where it is both necessary and desirable. In other words, the user of alternating-current tubes is not dealing with a crude undeveloped product but with one which has been carefully adopted to various specialized needs in the receiving set.

"THE radio industry has responded to the production of these tubes by adopting them on a large scale, and numerous receiving sets have been designed to employ them. Huge factory production plans have been drawn around them by leaders in the industry. In one concern alone there have been established most elaborate testing facilities of a permanent type to insure that the operating quality of the new tubes will remain at a high level," said Dr. Goldsmith. "There is nothing temporary about the production plans or engineering arrangements for manufacturing and testing this product. Nor

DR. IRVING LANGMUIR

*Much development and research work with vacuum tubes has been carried on by him*

is the general principle of their operation different from that of the tried and proven tubes of the past. The alternating-current tube has added a further successful and direct method of operating receiving sets from the lamp socket and the directions for using these sets is 'snap on the switch and listen'."

It is pointed out that the alternating-current tubes fall into two general classes; the filament emitter, or raw AC tube; and the filament-heater type. The former tube is the conventional bulb with the filament designed with the special requirements of alternating-current operation in mind, and operated from a stepdown transformer instead of a storage battery. The filaments are so designed that the fluctuating fields within the tube more or less counteract each other, while changes in the grid circuits are generally balanced out with a potentiometer.

The filament-heater type eliminates the filament altogether as an electron emitter, the filament acting as a heater for the cathode or emitter which surrounds the filament. The filament-heater type of tube is divided into two classes; the low-potential high-current type, and the high-voltage low-current type. The majority of alternating-current tubes now in use are of the former design. The high-current tube is favored by some designers with the idea of reducing the electro-static field around the filament, which is proportional to the voltage drop across it. The low-current tube is said to exist through a process of reverse reasoning, namely that it is easier to shield against an electro-static field of the nature encountered in the bulb, than in the electro-magnetic field. The shielding of the grid and plate is accomplished by means of the cathode which surrounds the filament heater.

AN alternating-current tube known as the "Arcturus," falls in this last group. The filament heater operates from a potential of 15 volts and consumes a current of .35 amperes. Aside from the electrical advantages of this design, the engineers call attention to the fact that the volt-ampere characteristics of the filaments are of particular convenience to radio-set owners or service men who convert battery-operated sets into electrical circuits, because an ordinary toy stepdown transformer can be utilized as the source of current for the heater. It is also practical to operate all heaters in parallel without the use of extra heavy leads, making it possible in many cases to use the original filament wiring. One side of the cathode is connected to the heater, adapting the tube to the standard four-prong base, thereby limiting the number of alterations which must be made to adapt a set for light-socket operation.

These tubes are made in three types, detector, amplifier, and power. The filament heater in each tube is of carbon, operating at a temperature considerably lower than that of the usual incandescent lamp, thereby insuring long life to the tube. Comparing the filament consumption of 4.5 watts to the candle-power with a filament of the ordinary carbon lamp consuming 3.5 watts per candle-power, the engineers estimate the life of each tube to be at least 1000 hours.

Tracing the development of radio from about six years ago reveals that the corollary of tube improvements in the past has been more efficient receiving apparatus. Six years ago the 201-type tube was in popular demand. This tube required a relatively large amount of filament power and consequently receiving sets were limited as to the number of tubes which could be employed because of the heavy drain on the storage battery.

DR. A. N. GOLDSMITH

*He is inspecting one of the new four-element vacuum tubes which may be regarded as a valuable index to the future of radio*

Next came the 201-A tube with a marked influence on the design of broadcast receivers. It required but one fourth as much power as the 201 type, and because of its low filament power consumption it soon became the dominating detector and amplifier in multi-tube circuits. Dry cells could be employed with this tube and therefore thousands of homes were equipped with radio, which for various reasons were unable to employ storage batteries and keep them charged. Strictly dry-cell tubes then made their appearance.

OTHER improvements followed, with the result that the power output tubes were introduced to improve the tonal quality and increase volume, because of their ability to handle large amounts of audio-frequency power without distortion.

The increased plate current requirements of circuits equipped with the new power tubes created a demand for "B" eliminators, which could supply the high voltage direct current from the light socket instead of from batteries. To meet this demand, rectifier tubes were developed to work in conjunction with the necessary accessories to convert the house-lighting current into direct current at any voltage required.

Then came the strictly light-socket set which dispenses with all batteries and battery eliminators. Thus the electrical era in radio has at last arrived through a process of evolution. The electrified receivers are not an over-night development nor like Topsy did they "just grow." Good electrical sets have been carefully planned and are based upon sound radio engineering principles which make them dependable in every respect.

# Curbing the Mississippi

## *Control of the Mississippi—a Stupendous Engineering Work Which Must Be Financed by the Federal Government*

By J. BERNARD WALKER

THE disastrous flood of 1927 proved that partial measures for control of the Mississippi River are ineffectual and that the task is of national magnitude and must be undertaken by the federal government.

So thoroughly was the Mississippi flood of 1927 described, both by correspondents of the daily press and by certain highly-placed officials of the government, that it is not necessary here to reiterate facts that are so well known. It is sufficient to confine ourselves to the statement that the total number of lives lost in the 1927 flood was greater than the recorded loss in all the previous floods combined; the loss of lives between 1902 and 1926 being 155, whereas the lives lost from drowning in the 1927 flood, as reported to the American Red Cross, reached a total of 246. The total property loss in all those years was about 208,000,000 dollars, and when final estimates of property loss are in, it is probable that total will be exceeded for 1927.

The recent disaster has convinced the American people that the time has arrived when they must enlarge their conception of the menace of the Mississippi and face it with the determination to place this great river under absolute control, be the cost what it may. It has taken time and a repetition of floods, culminating in the recent disaster, to enable the nation to grasp the stupendous magnitude of this menace. Down through the years we have been increasing the height of the levees, extending their length and making ever-increasing appropriations, in a sincere effort to control the floods and safeguard the people of the lower Mississippi Valley against an ever-present danger.

Unfortunately the previous efforts, local, state and national, were not well coordinated. Consequently the appropriations have never been made in sufficient quantity, nor were they sufficiently elastic to enable the engineers to lay down a policy of construction which they could follow out according to plan. Hence, successive floods have found, here and there, links that were weak, or altogether missing, in the 1880 miles of levees stretching through the Mississippi Valley from Cairo, Illinois, to the Gulf of Mexico.

In the main, where the levees had been carried up to standard height and built according to standard specifications, they stood up well during the recent terrific ordeal; but the government surveys which have been made since the disaster have shown pretty clearly that the levees must not only be made continuous throughout the full length of the lower valley, but that they must be considerably heightened and greatly widened if they are to present, as they must do, a reasonable margin of safety against a future flood that may overtop even the high record of 1927.

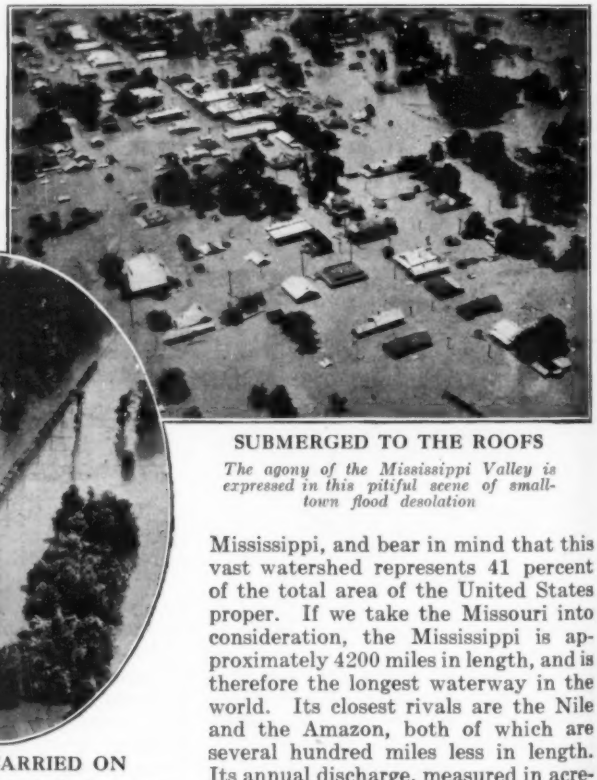
To be convinced of the immensity of this problem, we ask you to consider a few outstanding facts. We direct attention to our map of the United States, showing the actual drainage area of the Mississippi Basin. Note that the dotted line encloses an area of 1,250,000 square miles, all of the runoff in which finds its way, ultimately, into the Mississippi, and bear in mind that this vast watershed represents 41 percent of the total area of the United States proper. If we take the Missouri into consideration, the Mississippi is approximately 4200 miles in length, and is therefore the longest waterway in the world. Its closest rivals are the Nile and the Amazon, both of which are several hundred miles less in length. Its annual discharge, measured in acre-feet, is larger than that of any other river, reaching a total of 490,000,000 acre-feet. The next in discharge is the Ganges, with 390,000,000 acre-feet. Then follow the St. Lawrence, whose annual discharge is 185,000,000 acre-feet, and the Columbia River, 170,000,000 acre-feet. Note, moreover, that the great Nile River shows a total annual discharge measured at the Assuan

**STEEL SPAN CARRIED AWAY**

*Not merely frail wooden houses, barns, and chicken coops were swept away, but massive steel bridges*

**RAILROADS CARRIED ON**

*Although the Mississippi flood waters are up to the platforms of engine and cars, this freight train pulls through*



**SUBMERGED TO THE ROOFS**

*The agony of the Mississippi Valley is expressed in this pitiful scene of small-town flood desolation*

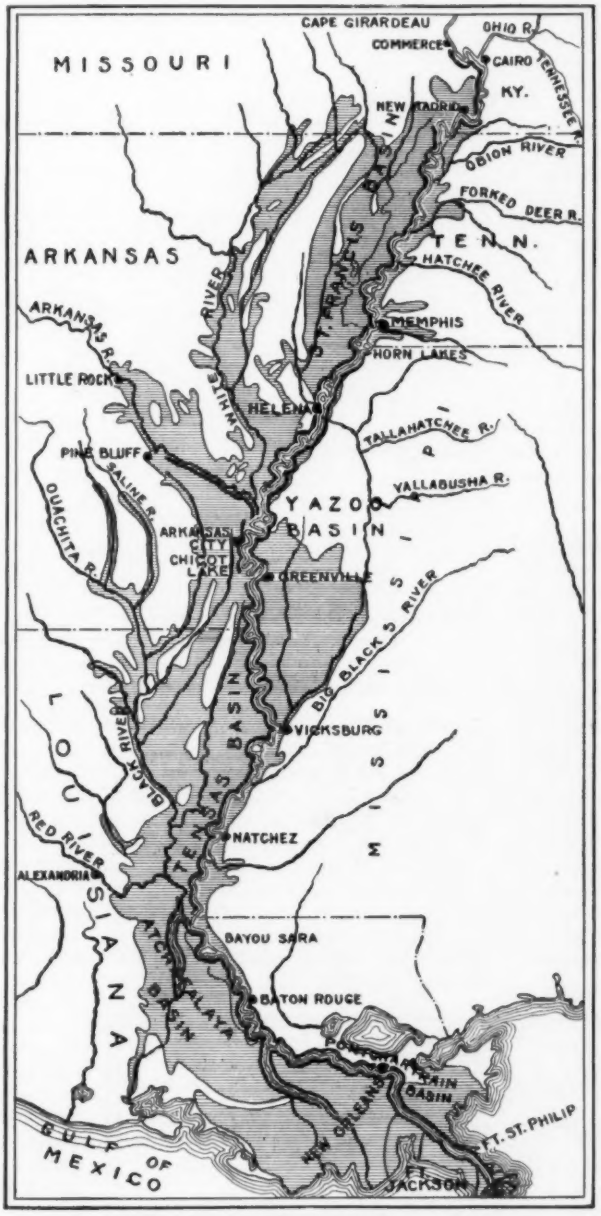
Dam of only 77,000,000 acre-feet.

Now turn your attention to the accompanying rainfall map, which shows that, in the critical months of March and April, 1927, the heaviest rainfall occurred in the lower Mississippi Valley, where for those two months alone it was from 18 to 25 inches. Note, moreover, that there is a rapid decrease in the rainfall in the remoter areas covering the headwaters of the river. Dams, reservoirs, et cetera, in those districts would hold back a negligible amount of water.

It was the unhappy coincidence of a continuous and unprecedented precipitation in the lower Mississippi, with high waters in its contributory rivers, which raised the river's stage far beyond any previously reached. As to the area under water, note that in 1897 the flooded area was 13,580 square miles; that in the flood of 1912 it was 17,605 square miles; in the flood of 1922 it was 13,200 square miles; whereas in1927, 23,000 square miles were under water.

WE now ask you to consider the map of the lower Mississippi Valley from Cairo to the Gulf, showing in double lines the meandering course of the river, with the existing levees marked in heavy black lines on either side. The Mississippi below Cairo flows through the deep alluvial soil of the valley and, as is usual in such cases, its channel meanders back and forth. Where the river is flanked by high land or bluffs, no levees are necessary. This will account for the fact that on this map there are stretches which show levees only on one side of the river.

It was inevitable that the early settlers along the Mississippi should endeavor to protect themselves against the ever-recurring floods. As far back as the year 1717, the colonists were building small levees or artificial embankments outside the river banks. By the year 1828, these works had been extended up the left bank of the Mississippi to Baton Rouge and along the right bank to the mouth of the Red River. Then the federal government came to the assistance of the local communities, and in 1850, with a view to raising a fund to reclaim the lands subject to inundation, all the unsold swamp land below the Ohio was granted to the several states along the Mississippi. This action of the government proved to be of great, though insufficient, assistance, and in 1879 there was created the Mississippi River Commission which was instructed to put into execution plans based upon recent government surveys for the improvement of the river.




**WHEN THE MISSISSIPPI BREAKS LOOSE**

*Map of the Mississippi Basin from Cairo to the Gulf. This is the stage on which was enacted the tragedy of the flood of 1927, when 246 lives were lost with 200,000,000 dollars damage*

At that time there was much dissatisfaction with the levee system as such, and its opponents claimed that as the levees were raised, the deposits of silt caused the bed of the river to rise also. Investigation at that time and since, however, has proved the falsity of this statement, and the most recent surveys show that not only is there no appreciable silting up but that there is an actual increase of the cross-section of the artificial waterway.

The annual report of the Commission for 1927 reveals that the United States has expended for levees a total sum of 71,000,000 dollars. A contribution of 15,000,000 dollars by local levee districts brings the total federal expenditure to 86,000,000 dollars. In addition to this, state and local organizations have expended about 152,000,000 dollars on levees, and this combined expenditure of 238,000,000 dollars is represented today by 1880 miles of levees containing about 500,000,000 cubic yards of material.

A levee is a simple earth embankment located, generally, at considerable distance in from the river bank; its exact location being determined by the topography of the ground, by the lay of the river, and by the general flood conditions. It is built by excavating the material from "borrow pits," located usually on the land side of the levee, the work being done by the use of the scraper and other customary methods.

THE accompanying drawing shows in dotted lines the cross-section of a standard levee of the latest type, as built in the Mississippi Valley. It has an average width, on the crown, of eight feet, with a freeboard of three feet. It is strengthened, on the land side, by banquettes 20 feet wide for levees from 10 to 13 feet high; 30 feet wide for levees from 13 to 16 feet high; and 40 feet wide for levees more than 16 feet high. For protection against erosion by rain, the levees are sodded with Bermuda grass and they are protected against the wash of waves by a layer of four inches of concrete, or by a board protection. Protection against bank erosion is of three types—the willow mattress, the articulated concrete mat, and the solid concrete mat. In our cross-section of the levees we show in full line a proposed cross-section for a higher, wider and stronger levee, designed to take care of a flood considerably larger even than the great flood of 1927. In this case the top of the embankment is widened from eight to twelve feet, the freeboard

is increased from three to five feet, and the land and the river sides have the flatter slopes of seven to one and four to one respectively as against the old slope of three to one.

The new levee cross section was determined by estimating the probable future maximum flow at Cairo of the Mississippi during a great flood. The flow in 1927 was about 1,800,000 cubic feet per second. The biggest possible flood would result if, to the maximum discharge of the Mississippi at St. Louis, there were added the maximum discharge of the Wabash at Mount Carmel; of the Ohio at Evansville; of the Cumberland at Nashville, and of the Tennessee at Florence. These combined totals would aggregate over 3,000,000 cubic feet per second. The combined maximum discharge of the Ohio and of the Mississippi at Cairo would be about 2,700,000 cubic feet. Now although, according to Colonel C. W. Kutz, a member of the Commission, such combinations may be classed as a possibility, it does not seem probable that rainfall sufficient to produce such coincident floods would ever occur.

THE larger levee above suggested would be based on an assumed maximum flood at Cairo of 2,250,000 feet per second. It will be noted that this assumed discharge is 25 percent greater than that of the flood of 1927. The increase in levee height includes a freeboard of five feet above maximum flood level as against the present freeboard of three feet, and this modification was generally recommended by the engineers of local levee districts as the result of experience with the 1927 flood. The flattening of the slopes of the levee, the increased freeboard, and the increased width of the crown were advocated so as to provide a largely increased factor of safety. The flattening of the slope on the river side will afford a means of protection against wave wash, and the flattening of the slope on the land side will greatly assist in reducing seepage which might otherwise reach such serious proportions as to cause breaks during long continued high stages.

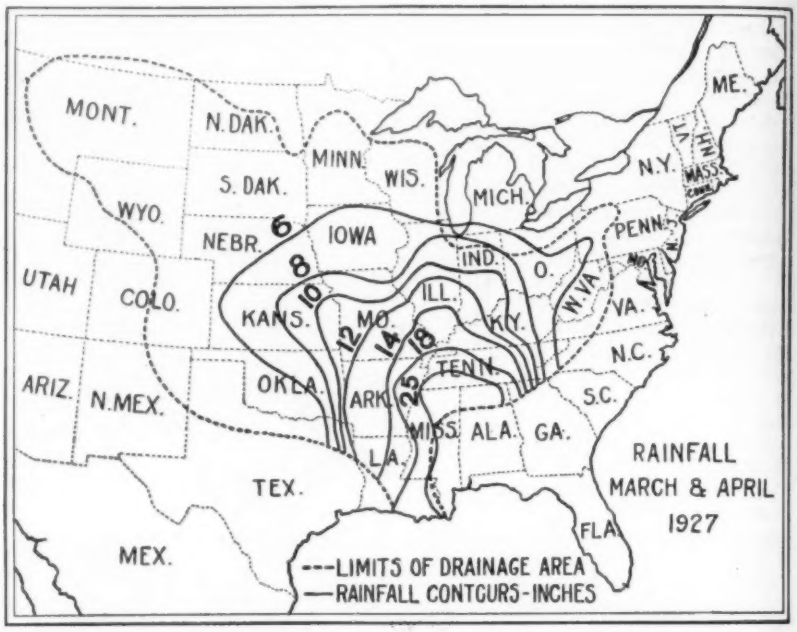
This great increase in the height and in the cross section of the levees throughout the whole 1800 miles of their length will, of course, cost much money, not less, probably, than 500,000,000 dollars.

There is a remarkably unanimous opinion among the engineers in charge of the various stretches of levees on the Mississippi, among the Army engineers, and among the members of the Mississippi River Commission, supported by that most able engineer, Mr. Herbert Hoover, the Secretary of Commerce, that in the construction of stouter and higher levees lies the solution of the Mississippi River problem.

As usual in an emergency of this kind, there are no end of earnest people who have their own particular ideas as to how the present emergency should be met. Some tell us that if we restore the forests which have been cut down, they will check the floods. Others tell us that by building dams and impounding the flood waters, the lower river can be maintained at a safe level. Others again would construct vast artificial concrete-lined channels parallel to the river and divert large portions of the flood waters through them to the sea. Others again would sacrifice large areas of the low-lying lands by permitting a portion of the flood waters to follow through old pathways and pass gradually down to the Gulf of Mexico.

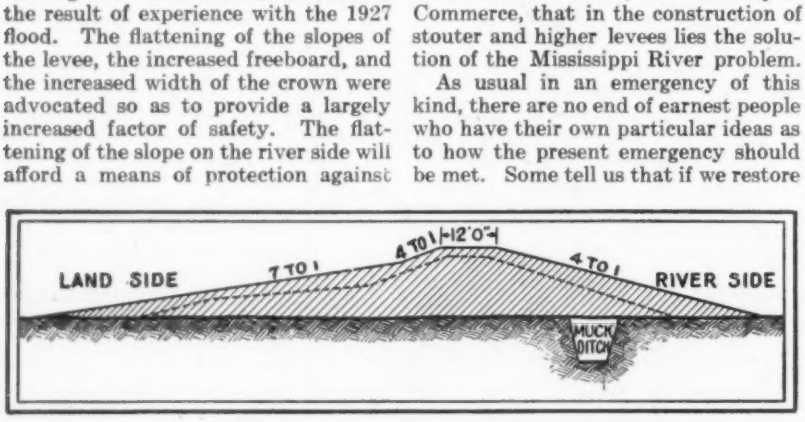
All of these alternate schemes are damned by the fact that their ultimate cost would be so great as to be prohibitive. As Mr. Hoover says, in referring to the proposed construction of reservoirs, "in the flood of 1913, if all the water flowing past Pittsburgh on the Ohio, all that flowing past St. Paul on the Mississippi, and all that flowing past Sioux City on the Missouri, had been held back by reservoirs, the flood waters south of Cairo would have been reduced by only about two percent." We should bear in mind, too, that the selection of the various dam sites for impounding the flood waters would present a serious problem in itself. Cultivated or valuable land would thus be flooded periodically—in times of high water—and this would mean perhaps as great a financial loss as would be entailed had no such precautions been taken. Impounding evidently is not the solution.

We are strongly of the opinion that the enlarged levee section, shown in our illustration, should be adopted for the whole main system of levees from Cairo to the gulf. In addition to this, having in view the possibility, remote though it may be, of even such a levee being overtopped, it would be well to provide at certain locations a system of regulated spillways by which surplus waters could be discharged and permitted to flow independently to the sea.




THE ENORMOUS AREA OF THE MISSISSIPPI WATERSHED

*All of the area within the dotted line representing 41 percent of the total area of the United States drains into the Mississippi River. Annual discharge 490,000,000 acre-feet*




ENLARGED LEVEE TO PREVENT FUTURE FLOODS

*The dotted line shows the cross-section of the average levee as now built. The full line shows the enlargement necessary to meet any probable flood of the future*

# THE SEWERS OF PARIS

THE elaborate sewer system of Paris has been featured so often in literature, and recently in moving pictures, that the photographs on this page will help to explain why it is considered the finest system in Europe.

As a rule, the sewers pass under the middle of the street, buildings being connected to them by pipes; and the gutters by channels. Four main sewers, or "collectors," each a vaulted tunnel about 15 feet wide, carry the water from about 600 miles of smaller ones to the Seine or to fields for fertilization purposes.

Photograph *Number 1* shows sewer men cleaning a small channel. Overhead are water pipes, pneumatic tubes, and telegraph and telephone cables. In *Number 2*, the men have dropped the front plate of a portable contrivance so that when a trap is opened at the bottom, the backed-up water rushes through at such speed as to effectively flush sand from the channel. Connection from one sewer to a lower one is made by a sloping gallery provided with steps, as shown in *Number 3*.

A scoop, illustrated in *Number 4*, lifts sand from the settling basins. For driving sand from the pipes called "siphons" which connect sewers on opposite banks of the Seine and which lie on the bed of the river, a hollow steel ball, covered with wood, is used. *Number 5* shows the ball being inserted at one end, and *Number 6* shows its exit from the other.

Although the slope of the sewers is slight, the large volume of water causes enough flow to prevent serious clogging. At some points, however, it has been necessary to install pumping stations. In spite this, a large force of cleaners is constantly at work.

This great system was begun in 1850 and is still being added to.

# Uncle Sam *Raises* Bugs

By NELL RAY CLARKE

UNITED STATES BUG FARM

THE United States Government has a bug farm. Here are raised dogs to support fleas, chickens to grow lice, and a group of hen houses have been built for chicken mites to play about in. Cabbages are grown to feed the cabbage worms and roses for the rose aphids. There is a special little doll house for the cockroaches, a warm dry home for the clothes moths and the carpet beetles, and occasionally an expert puts a big tub of water out in a quiet shady spot so that the young mosquitoes may wallow and tumble to their hearts' content. Once in a while the government increases its colony of insect inhabitants by adding several thousand bed bugs and other high-toned species of pests.

Orchard crops, truck crops, and greenhouse plants are grown so that the various insect pests and diseases may luxuriate under the most favorable conditions for health and comfort.

WHAT is all this for? Simply in order to be sure that the various insecticides offered for sale in the market to the trusting public will do what their makers claim for them.

When the Insecticide Board—now known as the office of Insecticide, Fungicide, and Caustic Poison Supervision in the new unit called the Food, Drug, and Insecticide Administration—of the United States Department of Agriculture was created by an Act of Congress in 1910, probably more than 90 percent of the preparations sold for the purpose of eradicating insects of various types were misbranded or fraudulent. Therefore the board established a testing station at Vienna, Virginia, a few miles from Washington, for the purpose of testing the efficacy of commercial products on actual living specimens under normal conditions and environment, thereby protecting farmers, fruit growers, market gardeners and stock and poultry raisers from fraudulent, misbranded, and adulterated insecticides and fungicides. What the Pure Food and Drug Act has done for the quality of the household products in the food market, the Insecticide Act has done for the insecticides.

When an insecticide is put on the market and advertised for interstate shipment or comes to this country from abroad, samples of it are collected and every claim made on its label is carefully checked at the insect farm by putting applications of the insecticide on each of the various insects it claims to eradicate.

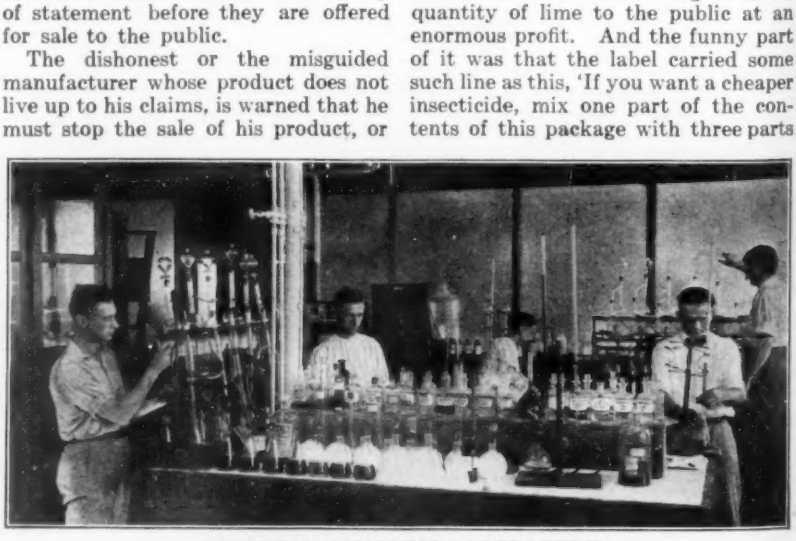
THE manufacturer is required by law to state on the label of the container either the names and percentage amounts of each active ingredient and the total percentage of inert ingredients or the names and percentage amounts of each inert ingredient. Many manufacturers submit to the government the composition of their products with a copy of the label they wish to use on the container and have them reviewed for accuracy of statement before they are offered for sale to the public.

The dishonest or the misguided manufacturer whose product does not live up to his claims, is warned that he must stop the sale of his product, or amend the label if some of his claims have been substantiated and some have not. If he then persists, he is fined. Sometimes a manufacturer protests the ruling of the government, and then the board takes the case into court. Continued disregard of the government's ruling means both fines and imprisonment.

The law also provides for the seizure of consignments of adulterated and misbranded products, thereby keeping the goods out of the channels of trade and away from the unsuspecting consumer.

"WE have found that, as a rule, honest manufacturers are glad of our co-operation, but we have had some funny incidents happen in dealing with the dishonest ones," said Mr. W. S. Abbott, the scientist in charge of the insect farm, as we visited the various insect colonies.

"One manufacturer sold a sample of an insecticide made of sulfur, arsenate of lead, and lime, which we tested and found to live up to everything claimed for it on the label of the container. Some time later one of our agents sent in some samples of the product of the same manufacturer done up in the same container with the same label, which upon test proved to be composed of lime alone. He had simply left out the two effective ingredients of his insecticide and was selling a small quantity of lime to the public at an enormous profit. And the funny part of it was that the label carried some such line as this, 'If you want a cheaper insecticide, mix one part of the contents of this package with three parts



CHEMICAL ANALYSIS LABORATORY

*Proprietary insecticides and fungicides are analyzed here to check up on statements of their composition, prior to actual test on living specimens. A good-sized laboratory staff is required*

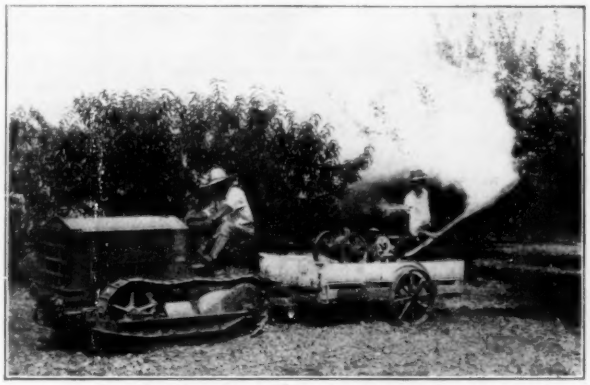
lime.' We went after him at once.

"Another manufacturer was selling liquid insecticide, about 98 percent of which was kerosene—incidentally an excellent insecticide in itself—for quite a high price and he recommended to his patrons that his product could be mixed with four parts kerosene to make a cheaper insecticide.

"ONE manufacturer sent in an insecticide containing four active ingredients never before used in an insecticide to our knowledge: eucalyptus leaves, angelica root, and colycinth pulp were three of them; and he claimed it effective against 10 kinds of insects. It took us quite a time to get all those ingredients and to try each of them out on the ten varieties of bugs. They proved effective against not one single variety of bug!"

One of the most valuable works the Office of Insecticide, Fungicide, and Caustic Poison Supervision is doing, however, is that carried on in the field whenever there is an immediate demand for control measures. For instance, during the ravages of the boll weevil, stations were set up in the cotton fields and work with the farmers was undertaken right on the ground. For quite a while after this pest was introduced into the country, the Bureau of Entomology knew of nothing which would eradicate or control it. Finally one of the scientists of that agency discovered that calcium arsenate would kill the boll weevil. There was a rush among manufacturers to turn out calcium arsenate in large quantities, many of them without the proper knowledge or adequate machinery for making the product. Much of it was so poorly made that it burned the cotton leaves and injured the cotton more than the boll weevil had done.

Chemists and inspectors were immediately placed in the cotton belt and shipments of inferior calcium arsenate were stopped right there, so little of it reached the cotton. Thereby cotton growers were protected from a substance which would have ruined their crops. Many foreign shipments of calcium arsenate which would have burned the cotton to the ground were also stopped before any damage was done.



POWER INSECTICIDE DUSTER

*This motor-driven dusting machine blows clouds of poisonous powder on insect-infested trees to determine if it is as efficacious as the manufacturer claims it to be in eradicating certain tree pests*

"Do you breed most of the bugs you want for testing out the insecticides?" Mr. Abbott was asked.

"Yes," he answered. "Occasionally we get all of our chickens so clean that we have to go out and buy a few in order to get a new crop of lice. Market men never like to admit that they have any chickens with lice on them, but when you go to market looking for chickens with lice, you can usually find them. We buy the lousy ones and the lightweight fowls which are apt to be lousy. Our neighbors all over this section of the country know us, and they send for us when they get in trouble, thereby affording us additional source of bugs.

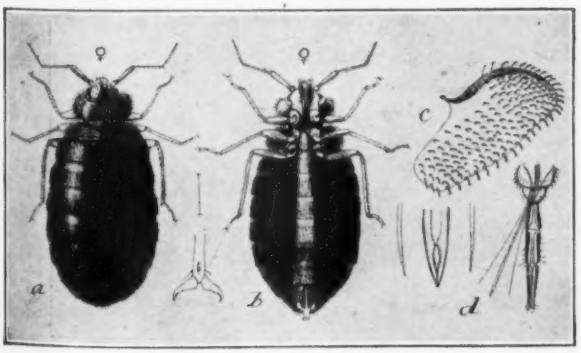
"WE trap our cockroaches in Washington and bring them out when we need them. We make a trap much like the ordinary fly trap: a glass jar with a paper cone inside. We bait this with bananas, sour milk or bread dipped in sour milk.

"We used to raise our bed bugs on guinea pigs, but we found it much cheaper to buy them. I got into the worst scrape in the history of the farm once when it got noised abroad that I wanted to buy some bed bugs. One day when I dropped into the barber shop, the barber twitted me about buying bed bugs. I laughed and said that I would take 2000 then and pay one and a half cents apiece for them.

"THE barber told a newspaper reporter, who put the story on the front page of the newspaper. A national news service copied the story and we got bed bugs from all over the country. They came in boxes and bottles and even in envelopes. Finally, in desperation, I had to prepare a form letter to answer all the inquiries and get the newspaper to publish the fact that we needed no more bed bugs. I never have to worry about getting bed bugs any more; there is a man in Washington who can furnish me 2000 on 24 hours' notice," Mr. Abbott added with a laugh.

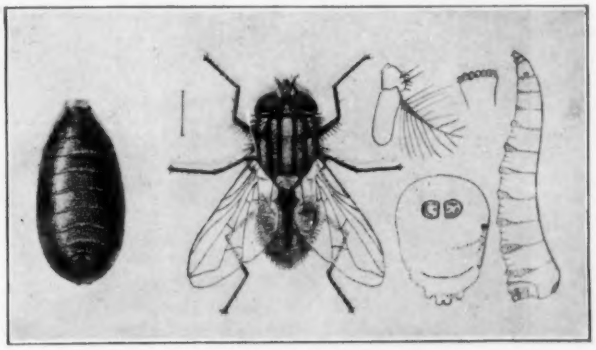
"We grow all sorts of plants here for the sake of getting various types of insects," he continued. "Currants and gooseberries for the currant worm, and fruit trees for the aphids and the various kinds of scale, asters for root lice, roses for aphids and lice, and chrysanthemums for the fly that eats the buds.

"We also raise large quantities of flies, and the dogs are always available for trying out the flea remedies. We clean them up about as often as the average person does his dog, but they get fleas again from somewhere. We can easily bait ants to particular places for testing out insecticides which are supposed to kill them or drive them away. Scale insects usually have to



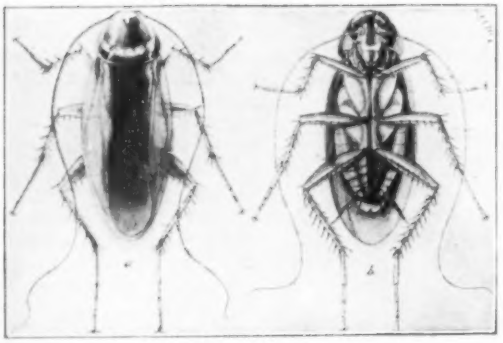

ADULT FEMALE BED BUG

*Upper and lower views of this familiar and much detested insect. C and D show rudimentary wing pad and mouth parts—enlarged*



COMMON HOUSE FLY

*Fly exterminating compounds—liquids, powders, et cetera—are constantly being tested. Here are shown pupa, larva, and adult*



AMERICAN ROACH

*When the experts of the bug farm need a supply of these odious creatures that infest the kitchen sink and wall cracks, much to the disgust of housewives, they go into neighboring towns and usually manage to find them in great quantities*

be handled in the section of the country where they are doing particular damage at certain times. A year or two ago when they were doing so much damage throughout New England, we sent our men right to the orchards to do their test work.

"We kill off our own potato bugs and then we go out into the neighbor-

TEST TREE

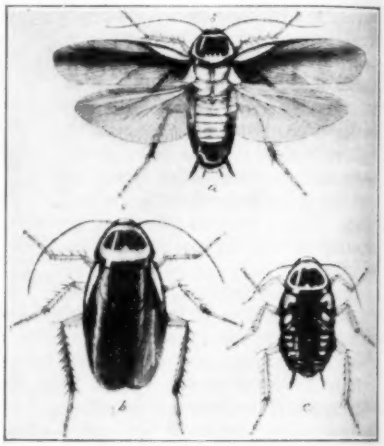
*Defoliated by using improper insecticide. This is what happens if claims are untrue*

hood and bring some to our potato patch. When we want to test out an insecticide which is supposed to kill cutworms, we put down some boards on the grass of the lawn, for the larvae of these moths will gather under the boards during the night and we get them in the morning. We don't try out insecticides for keeping away ticks—that work is done by the Bureau of Animal Industry.

"Occasionally it is necessary to test out some of the insecticides for the household pests in their natural environment and then it requires tact on our part to approach housewives to get permission to make our experiments. If permission is given us to try out a certain kind of insecticide, we always make the promise that if the first attempt does not eradicate the bugs, we will clean them up within three days, as well as any dirt or disorder we have made. Sometimes people write us and ask us to clean up their houses of certain types of bugs, and if they are located in a locality convenient to our station, we are nearly always able to do so with official samples.

"IN testing out the mosquito remedies, one of us rolls up his sleeves, applies the insecticide or preventive to one arm, leaving the other arm bare, and then goes out in the woods and sits on a log to watch results. Sometimes the victim goes fishing. We occasionally have to raise our mosquitoes by putting out tubs of water and catching the young mosquitoes just as they emerge from the water. These are released in a room where tests can be made according to directions appearing on the label.

"At the present time we are making a fight against preparations which, it is claimed, can be put in drinking water of chickens to kill lice. The claim of the manufacturers of such products is that when the chickens drink the water containing the insecticide, the sulfur content gets into the blood and makes sulfuric acid, which comes out of the chicken's sweat glands and kills the lice when they bite the

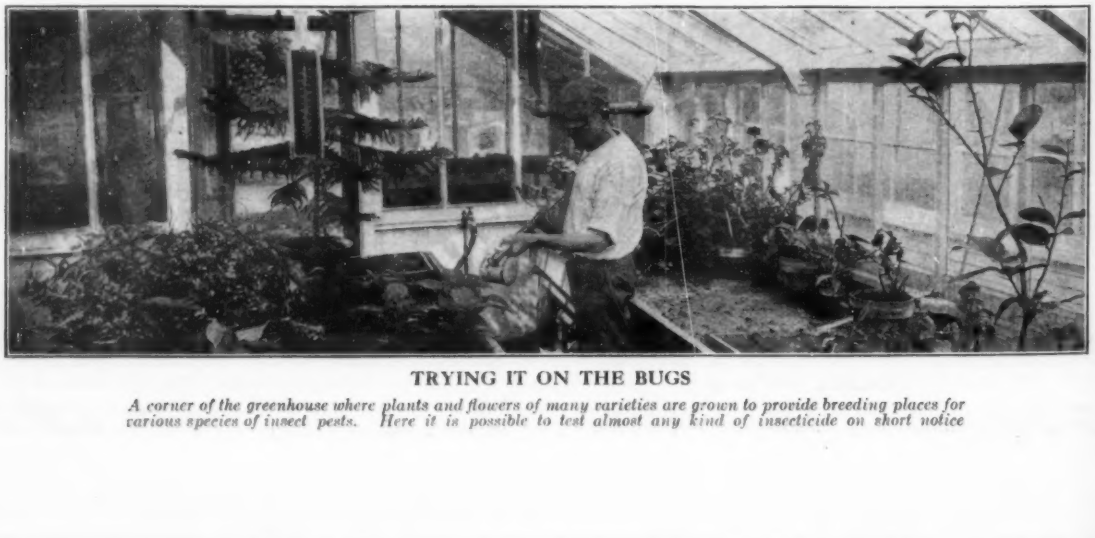


TRUE COCKROACHES

*These fly at night and are different from the common house roach which does not fly*

chicken. It is a beautiful theory, but it does not work out in practice. In the first place the chicken has no sweat glands. Furthermore the scheme is a fraud from beginning to end, for the preparations usually consist of a chemical which the manufacturer buys for about 30 cents a gallon and retails to his customer at about one dollar for a two-ounce bottle."

No original research work for the purpose of attempting to find new insecticides is done at the bug farm at Vienna. That work is taken care of by the Bureau of Entomology and the Bureau of Chemistry and Soils.



TRYING IT ON THE BUGS

*A corner of the greenhouse where plants and flowers of many varieties are grown to provide breeding places for various species of insect pests. Here it is possible to test almost any kind of insecticide on short notice*

# Growing Mountains

## *Volcanoes Occur Where Mountains Are Being Elevated. This Is More Than a Coincidence—What Does It Signify?*

By BAILEY WILLIS, C. E., Ph.D.
*Emeritus Professor of Geology, Stanford University. President, Seismological Society of America*

THE Earth is not dead. It was not made, finished, and set rolling on its orbit, dead as a stone. It is a globe highly charged with energy. It owes its rounded form to the universal attraction of gravity and to the centrifugal force produced by rotation on its axis.

We are familiar with gravity, of course. It is the attraction that made Newton's apple fall, that holds us to the ground, and which even determines the size of our bones, since they must carry our weight. The stone that killed Goliath flew with centrifugal force from David's sling. The same force throws the mud off of our tires and spreads the Earth at the equator, causing a flattening at the poles.

Gravity and the centrifugal force are essentially constant at any point on the surface of the globe and, balancing each other, they hold it firmly to its spheroidal form. If they affected all parts equally, the earth's surface would be smooth. In that case the solid globe would be covered by the ocean waters about a mile deep everywhere, there would be no dry land, and we would all be fishes, or akin to them. Some might be clams, some sharks, and a few, perhaps, king salmon.

Gravity, however, does not act equally upon all parts of the great globe. It would be very remarkable if the earth were so homogeneous. We might expect that some large masses would be lighter, some others heavier, and that is actually the case. The continents consist of relatively light rocks; the masses beneath the oceans are composed of relatively heavy rocks. The differences in density correspond closely to the differences of elevation between the heights of land and the depths of ocean basins and from this general relation, geologists draw the conclusion that the great masses of the continents are in balance with the bodies under the oceans. This condition implies a certain mobility, a tendency to slow adjustment of the surface to the loads that it supports.

On the other hand there are evidences of very great stability during long ages, ages of such duration that mountain chains may waste away to low plains without any response on the part of the Earth, toward a re-establishment of equilibrium. A volcano many thousand feet in height may be piled up and remain supported for an indefinite period. Ocean deeps, which are hollows sunk far below the average balanced level, not only remain as excessive deeps, but even deepen. These facts point to a certain degree of rigidity in the Earth and limit the idea of mobility.

YOUNG MOUNTAIN RANGE

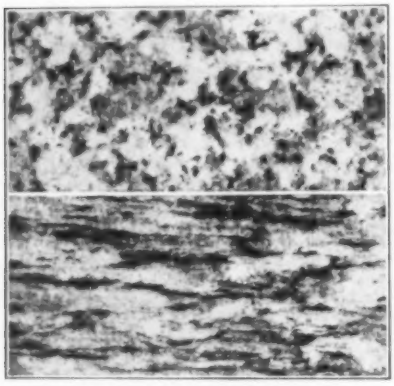
*The Rocky Mountains at the 49th parallel, where they have been pushed seven miles eastward over the plains. The monument marks the boundary between Alberta and Montana*

ANCIENT GRANITE, QUANNAH RIDGE, OKLAHOMA

*Ages ago this granite, as it subsided, was buried under thousands of feet of sediment. Later it was elevated, forming part of a mountain ridge, and the sediment was croded away*

Geologists weigh these contradictory evidences with various degrees of emphasis. "Our Mobile Earth" is the title of a widely read book by a distinguished scientist who leans to the extreme idea of a plastic globe on which the continents have drifted apart, floating in a substratum that is conceived to resemble sealing wax in its capacity to yield gradually to small but continuing forces. Others, of whom I am one, incline to the theory of a good, solid Earth. I regard the evidences of stability as vastly more significant than those of mobility; I consider the continents and ocean basins as essentially permanent features of the surface; and seek to interpret the disturbances of equilibrium including earthquakes, which have undoubtedly occurred and are occurring, as local phenomena due to special conditions in various parts of the earth.

Obviously that view calls for the action of other forces than the universal and practically constant attractions of gravity and the centrifugal force. There must be some activity that disturbs the balance. What is there that may play the role of a stimulant to action?



EARTH LABORATORY WORK

*Above: Granite crystallized from molten state. Free from unequal stress the crystals grew in all directions.* Below: *Gneiss, re-crystallized from granite. Here the crystals, under uneven stress in deeply buried rocks, grew in the direction of least pressure*

In seeking the answer to this question, a certain type of mind soars into the realms of speculation. The unknown or the little-known attracts the explorer of science. A few facts suffice to equip his airplane; he rises on the wings of a plausible argument; but he usually falls far short of the discovery of Truth. A recent work which would actuate the career of the Earth by the radio-activity of rocks, regarding which our knowledge is inadequate, belongs in this class. We may admire the intrepidity of these intellectual aviators, but we fly with them only at the risk of a crash.

IT is wise to stick to the established facts of common knowledge. They are romantic enough. We heat a black stone, anthracite, until it glows and it yields far more heat energy in burning than we have used to raise its temperature. That energy was stored up in its molecules. We heat a mixture of lime, clay, and quartz sand till it softens; we cool it, grind it, and call it cement. When mixed with water it sets to a hard stone, which is a chemical combination of the lime, clay, and quartz or silica of the original rocks. We observe that many rocks turn brown on the surface and become soft or rotten. They have yielded to the action of moisture at the ordinary temperature of the air, have been changed chemically, have formed new minerals. That is the point upon which to fix our attention: new minerals may form from older minerals in the laboratory of the Earth.

Geologists are very familiar with the changes which minerals may undergo. Petrified wood presents a case in which the woody fibre has been replaced by silica. Many ore deposits are bodies in which a barren mineral has been replaced by the compounds of the precious metals. There is a great class of rocks called "altered" or "metamorphic" because they have re-crystallized and are made up of new minerals developed by chemical changes of the old. The metamorphic rocks are particularly interesting in this search for the forces which may cause local changes of the Earth's surface, because they demonstrate the intensity of action at depths beyond our immediate reach.

As an example of a metamorphic rock we may cite gneiss, a pepper-and-salt colored rock with abundant mica-flakes, which is of common occurrence in the eastern United States and Canada. It is characterized by its distinct tendency to split in one direction, like wood, and always parallel with the silvery mica flakes. This was not, however, the original form of the rock. It was once a granite, a rock that consists of similar minerals, but without the parallel arrangement. And the reason is this: Granite is formed by cooling from a melted condition. In the liquid, molten mass the conditions of pressure were equal in all directions and consequently the crystals that formed as the mass cooled, developed equally in one direction or another without any control. But when the solid granite re-crystallized into gneiss, it was under unequal pressures. There was in such a case one direction of greatest pressure and another of least pressure or least resistance. The crystals grew toward the least resistance, rather than toward the greatest pressure; for they also obey the law of least work that runs through all Nature's operations.

Thus it happens that the rock assumed a distinctly elongated structure. The atoms and molecules rearranged themselves in the crystals, the crystals assumed long and narrow or flattish forms, and the whole mass of granite changed its form correspondingly. The mass grew narrower one way and longer in another dimension, and these changes occurred down in the Earth, where there are no vacant spaces, where the elongating mass must push other masses out of the way as it grows.

Here, then, is a disturbing condition which may arise among the rock masses of the Earth's crust. Let us summarize the steps of its development.

THE globe is solid. The familiar idea, which was universally accepted fifty years ago and is still unquestioned by the general public, that the interior of the Earth is molten, has been disproved. There is a small nucleus, extending from the center to about one third of the radius, which is either so solid or so mobile that we can get no information from it. Through all the outer and greater portion of the globe, however, earthquake waves pass freely. They are elastic waves, which only an elastic solid could transmit. Not a day goes by but from some point near the Earth's surface these elastic waves are sent out by an earthquake shock and are recorded by the instruments set up in many countries to receive them. These messengers from the other side of the world tell us every day that they have come through solid rock, or if not through the rocks familiar to us, through some substance even denser.

The Earth is very hot in the interior. It would be molten except that the pressure due to gavity, due to the weight of the mass as it presses toward the center, keeps it from melting. Here in another balanced condition, but unlike the balance of gravity and the centrifugal force, it is a condition that is likely to be disturbed. While the pressure due to gravity re-

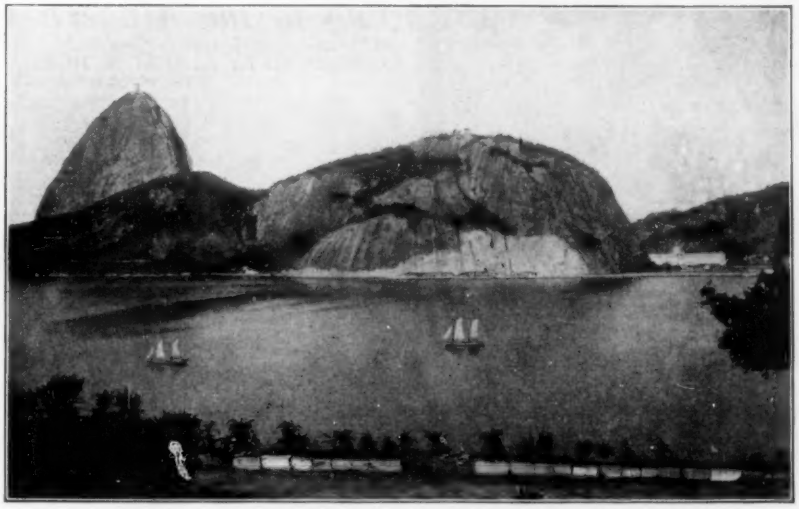
RE-EMERGENT

*Church Rock, Clovelly, England. This is a good example of an ancient sea bottom pushed up during the growth of an old mountain range. The ancient rocks once lay deep beneath other rocks, and during some earlier geologic period they have been folded. Later, the superincumbent rocks were eroded away. Still later the same rocks reached the surface of the sea and were eroded by wave action, their rounded forms being shown in the foreground. Continued elevation during mountain growth has now pushed the entire mass high above the tides, forming a "raised beach," high and dry*

mains practically constant at any point, the temperature may change. Both pressure and temperature are very high fifty miles below the surface. They are titanic giants wrestling unceasingly to control the form and constitution of rocks. Attendant upon them are the atomic forces which maintain the chemical composition and the crystalline structure so long as pressure prevails, but which may swing to the side of the heat giant if he becomes dominant. Then crystals change in constitution and form with a power that is limited only by the crushing strength of their own substance. The mass spreads laterally, shearing, folding, or displacing adjacent masses; or it pushes upward, raising the surface of the Earth in mountain arches and blocks.

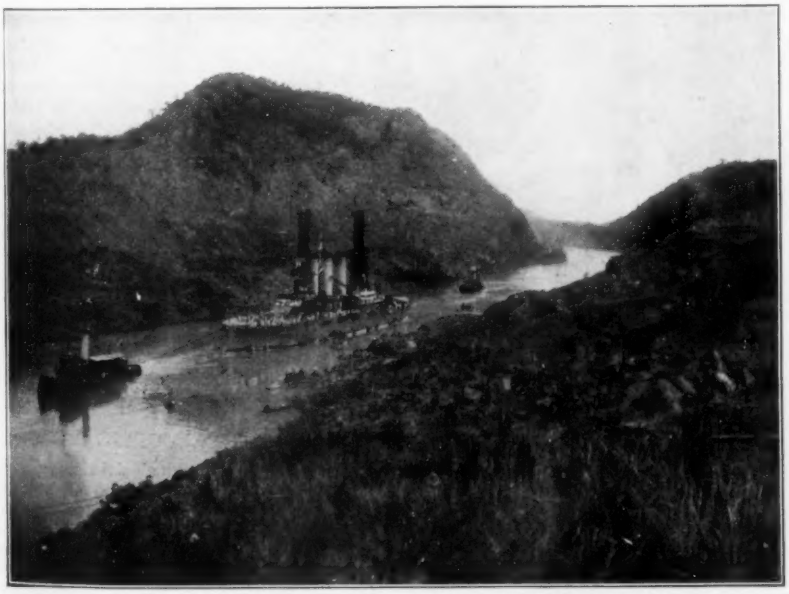
This suggestion of a local cause of mountain uplift is not yet accepted by a majority of geologists. It has not yet received the stamp of common approval and must submit to rather searching inquiry before it can receive that approval. But after some 40 years of study of the facts and theories relating to the dynamics of the globe, I find it the most promising explanation of the changes to which geologic history bears witness, and am seeking methods of testing it further. Advisedly I say "of testing it." It is easy to prove almost any theory to your satisfaction, but quite another matter to test it to the point where it can no longer be doubted.

Earthquakes are among the incidental phenomena connected with the growth of mountain ranges. The great mountain chains of the globe are young and are growing. They are active, and one expression of their activity is the occurrence of earthquakes. Volcanoes are a more extreme result of the same forces. If there is anything in the theory that heating and recrystallization are causes of mountain uplifts, then there should be a relation between the distribution of earthquakes, volcanoes, and recent displacements of the Earth's crust. To test this connection I have made a journey throughout the principal earthquake regions of the world during the past year. I caught up with only one, the shock of July 11, 1926, in Palestine, but it was a good one. And elsewhere the frequency of earthquakes, the distribution of volcanoes and the activity of young mountain growths bear so intimate a relation to one another that there can be little doubt of a common, local cause.



GRANITE MASSES, HARBOR OF RIO DE JANIERO, BRAZIL

*These granite rocks have been pushed up from a depth of a mile or more beneath the surface to their present altitude of eight hundred to fourteen hundred feet, due to recrystallization of rock more deeply buried and its alteration to gneiss with vertical elongation*



NATURE PLAYED A COSTLY JOKE ON UNCLE SAM

*Until comparatively recent geologic times, the North and South American continents were separated. There was no Isthmus of Panama. In elevating a ridge connecting the continents Nature played an expensive joke on the United States—the Panama Canal had to be dug*

Japan, the Philippine Islands, New Zealand, and also the northeastern shores of the Mediterranean lay along the route of travel. Chile and California had previously been studied. In some of the lands volcanoes are active and numerous. In others this extreme phase of heating is absent, but earthquake shocks, the vigorous growth of young mountains, and the occurrence of the kinds of rocks which would be capable of the required crystallization below the surface are associated phenomena.

The facts seem to sustain the theory.

THIS intellectual child of mine is something over twenty years old. It seems to deserve a name. Its ancestral line in the family of scientific research is the study of changes in rocks and minerals, and that family name is "Metamorphism," meaning the *process of change*—let the child's first name be "Metamorphic" or *related to change*. It is a well established practice to associate the family name with the occupation of the family. We have the Smiths, the Bakers, and so forth. Now the occupation of this child's family is to produce mountains. There is a Greek word for mountains, namely *oros*, and the genesis or development of mountains has been called *orogenesis*. That is evidently the child's family name.

I beg to introduce "Metamorphic Orogenesis."

# Household Inventions

## *Interesting New Devices That Are Both Useful and Time Saving to the Modern Housewife*

CONDUCTED BY ALBERT A. HOPKINS

### HEAT MAKES COLD

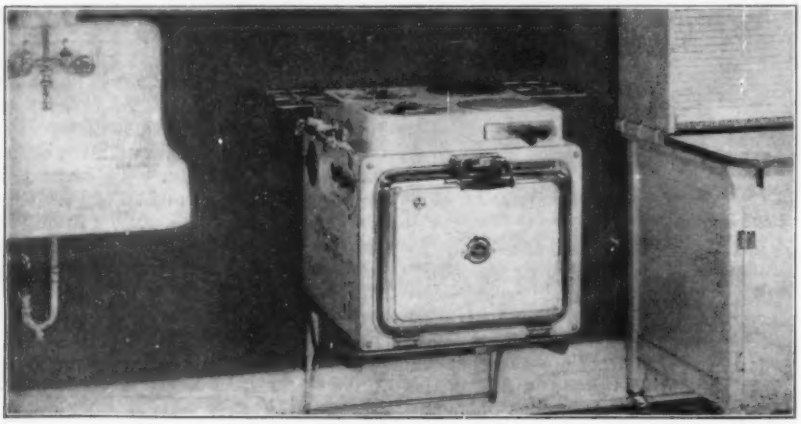
In contrast with the many types of electrical and gas-operated refrigerators on the market today, we now have one that can be employed anywhere that a means of applying heat is available. It is illustrated above and in the two photographs at the right. The basic principle on which it works is very simple: A liquid is evaporated from one of the large balls to the other by the application of heat, and condensed. When it again evaporates, it absorbs heat from the surrounding atmosphere and passes back to the other ball. The cycle of heating and using can then be repeated hundreds of times

### THE "HOT" AND "COLD" BALLS

To make ice cubes or frozen desserts, the material to be frozen is placed in the tray shown and inserted in the tube of the "cold" ball. Here a temperature of zero or somewhat below is produced and maintained for 24 hours or more

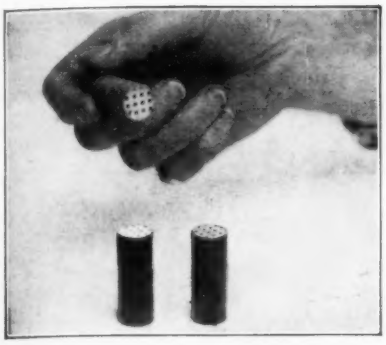
### OPERATION

To use this new iceless refrigerator, the "cold" or smooth ball is placed in a pail of water and the other or "hot" ball is placed over a gas plate, oil heater or other source of heat. A special oil burner for the purpose may be obtained. In about one hour, a whistle on the "hot" ball announces that heat enough has been applied. The unit is then removed, the "hot" ball placed in water for a few seconds, and the "cold" ball is replaced in the cabinet. The "hot" ball remains outside as shown above. The heating must be done on an average of once a day—less in cold weather, but never more frequently



### ◄ AUTOMATIC ELECTRIC RANGE

In this newly designed electric stove, the thermostatic regulator may be set at any temperature desired and the unit or units will heat to and maintain that temperature. There is also an eight-day clock which is equipped with a circuit breaker. When the cooking time and proper temperature for a certain food has been determined, the two units can be set and the cooking will automatically stop when the food is done. Other advantages of electric cooking are too numerous to mention here. The electric current is controlled through two mercury-tube switches, one attached to a thermostat and the other to the mechanism of the clock. All of the parts are readily accessible for repair and replacement, including the heating units and switches

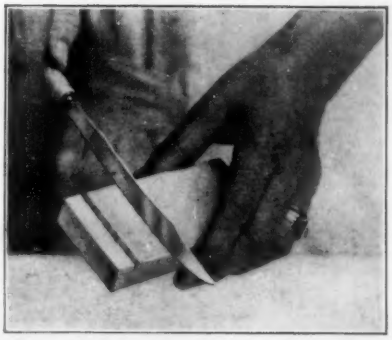


### PAPER CONTAINERS

A simple solution of the problem of carrying salt and pepper in the lunch box or on picnics is the use of the practical paper containers shown at the left. They are light, strong, compact and very inexpensive

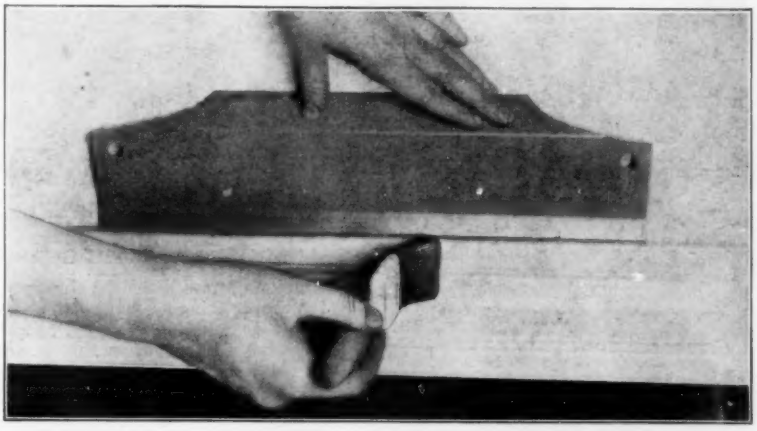
### KNIFE SHARPENER

By drawing the blade of a knife through the groove shown in the whetstone at the right, both sides of the edge are ground and the knife is sharpened to a fine edge without danger of damage to the fingers



### PAINT SHIELD

The device illustrated at the right will protect the wall paper or panes of glass when the woodwork is being painted. In use, the shield is moved along as the painting progresses. Work is expedited, because there is no longer any need of being very careful that the paint goes only on the wood. If the brush strays from the wood, the paint gets on the protector—not the paper or glass

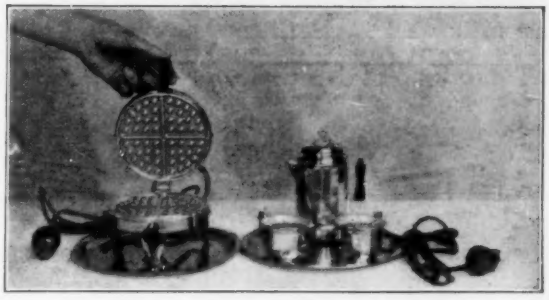


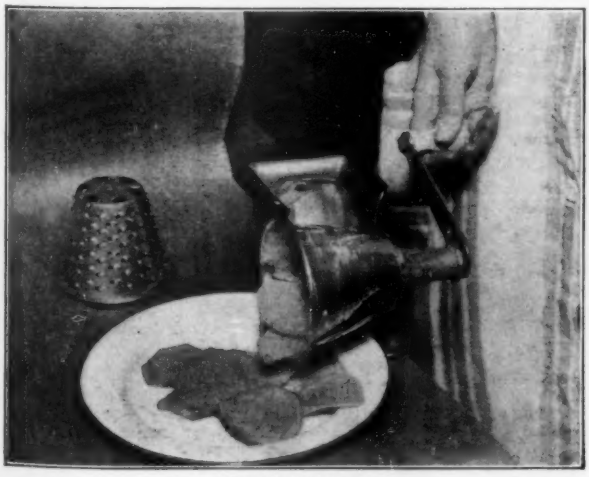
### VAPORIZER

The electrical vaporizer shown at left throws off fumes from special crystals that kill moths and eggs, thus saving clothes

### TOYS

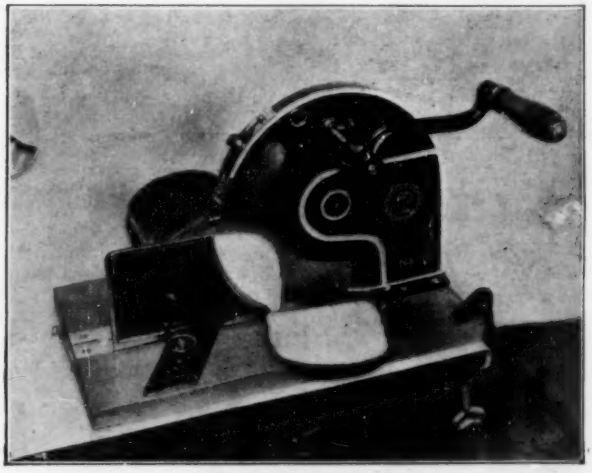
The miniature electric utensils shown at right work just like the full-sized ones. They instruct and amuse the children





**KITCHEN KIT**

By means of the various cutters supplied with it, the handy kitchen tool shown above may be used for slicing vegetables and fruits, grinding cheese, nuts and chocolate, grating ice, and performing numerous other kitchen duties



**BREAD SLICER**

Hailing from Germany, the above illustrated bread slicer cuts the loaf economically. The feed is automatic and can be adjusted so that the slices will be of any desired thickness, and will all be uniform, thereby eliminating waste

# Inventions New and Interesting

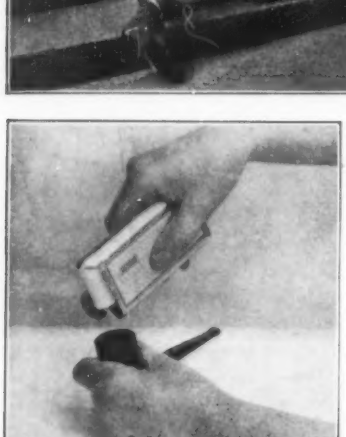
## *Something New Under the Sun to Give Comfort and Help Us in Many Ways*

### ◂ RAINY DAY SPLASH GUARDS ▸

Fashion decrees that light stockings are the proper thing for women this season. Rainy days, wet pavements, and automobiles—a combination that is not at all conducive to a happy frame of mind to the wearer of colorful hose—come with winter but just the same the stockings can be kept clean with the guards shown here. This new protector is fastened by means of straps

### FILING CABINET AND SAFE

This new cabinet combines fire and theft protection for valuable papers. The double wall of the entire cabinet is asbestos lined. The two lower sections are regular filing drawers and the top one is a strong, burglar-proof vault

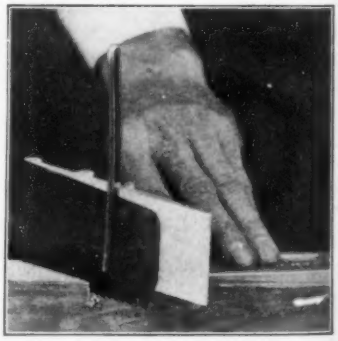


### ◂ METAL TOBACCO POUCH

Similar to a metal cigarette case is this new pouch for carrying the "makings" for the man who "rolls his own" or for the one who smokes a pipe. Tobacco carried in this pouch does not crumble as it will in a fabric or rubber container

### ANGLE-FINDING SAW GUIDE ▸

With the new miter saw guide shown to the right and below, it is easy to set for any angle of cut. The upright guide fin swings on an end pivot joint, the angle being determined by graduations on the base plate, and set by means of a set screw. Makes a joint that fits perfectly because the angle will be correct without guessing. It is compact and light and may be used by a skilled or unskilled person ▾



### MAGNIFIER

Both eyes can be used with this wide-field glass, it can be adjusted to any height; the glass always remains parallel to the table surface, and the object being studied is lighted by means of a shielded lamp

# The Scientific American Digest

## *A Review of the Newest Developments in Science, Industry and Engineering*

CONDUCTED BY ALBERT G. INGALLS

### Telephotographs Used Mostly By Business Men

TELEPHOTOGRAPHY, the process by which photographs and other illustrations are sent over long-distance telephone lines between New York and San Francisco, and other parts of the country, is being used mostly by the business man. This is the announcement of W. E. Harkness of the American Telephone and Telegraph Company. It was at first expected, he says, that newspapers would be the principal users when they wanted news pictures in a hurry. However, while the newspapers do make wide use of the process, it is irregular, since events of sufficient importance to warrant the expense do not occur every day.

One interesting use of the system by financial houses has been as a substitute for long telegrams. A 1500-word message, typewritten on ordinary letter-size paper, can be sent in two pictures. As the negative made at the receiving end can be used to make a number of prints which can be mailed by air mail to nearby cities, a speed nearly as great as with telegraph can be attained at less cost, and with no possibility of error. In one case an affidavit necessary in connection with a large bond issue was required in New York the same afternoon that it was made in Chicago. It was sent in time by telephotography at a cost of $20, and a large financial loss and delay were prevented. Photographs showing the latest styles in hats and dresses, and photographs for birthday and Christmas greetings have also gone over the wires. Also, Mr. Harkness states, telephotography is the only known means by which Chinese and Japanese can be transmitted in the native characters.—*Science Service.*

### California Steam Wells Examined By Scientists

STEAM wells, where the earth is tapped for natural heat as it is elsewhere for natural gas or oil, promise to deliver power in paying quantities.

The first development of this kind in America, at "The Geysers" in California, has been given a thorough scientific examination by Dr. E. T. Allen and Dr. Arthur L. Day of the Carnegie Institution of Washington, and their report has just been made public.

The steam-well region is in a little valley in the Coast Range, near San Francisco. There is abundant evidence that the region saw much volcanic activity in the past, and the steam rising through the earth, causing fumaroles and hot springs, is probably the product of deeply buried lava that has not yet cooled. The name "The Geysers," however, the Washington scientists state, is a misnomer, for there are no active geysers in the valley and no signs to indicate that there ever were any.

Nevertheless, there seems to be abundant steam at high temperatures and pressures when the borings are sunk. Eight wells have been put down so far, to depths of between 200 and 650 feet. These develop steam pressures between 60 and 275 pounds per square inch. Quantitative measurements of the output of four of the wells indicate a power equivalent to 4500 kilowatts, or over 1000 kilowatts per well.

In spite of the borings, no diminution of steam flow at the natural fumaroles in the valley has been noted. Neither do the wells seem to diminish each other's activity, although two of them are within 50 feet of each other. In fact, all the wells have shown an increase in both the pressure and temperature of their steam for a certain period after being opened.

A similar enterprise on a larger scale has been conducted at Larderello, Italy, where the commercial production of power has already been realized. The California development has one advantage over the Italian wells, in that the Larderello steam contains corrosive acids which necessitate more or less elaborate purifying processes before it can be used, whereas the California wells yield a steam whose acidity is so low that it can be used in its natural state.—*Science Service.*

### The *S-4* Disaster

JUST as we go to press comes the distressing news of the sinking of the submarine *S-4*. Every available facility is being rushed to the scene; the Navy's expert divers were sent by automobile; Captain King who successfully raised the *S-51* (see October, 1926, issue of the SCIENTIFIC AMERICAN) was sent by seaplane to take command; Commander Ellsberg who won fame for his work and inventions on *S-51* was recalled from civil life; helium for the divers, the big pontoons, the underwater torch, drill and lamp, all perfected since the former disaster, are at hand. Everything humanly possible will be done, but unless the weather moderates nothing will avail to save the lives of the men aboard. The *S-4* will be raised but the men seem doomed.

### Forests Felled to Control Treacherous River

CONTROLLING the treacherous Missouri River is a task that calls for the use of tons and tons of materials, mostly in the form of felled trees and concrete piles. To control the current as desired, current retards are prepared. Trees are hauled to the river, made up into units on barges and towed to the spot where they are needed.

Structurally the retard is composed of trees that are assembled in a series of rectangular cribs set side by side or end on end

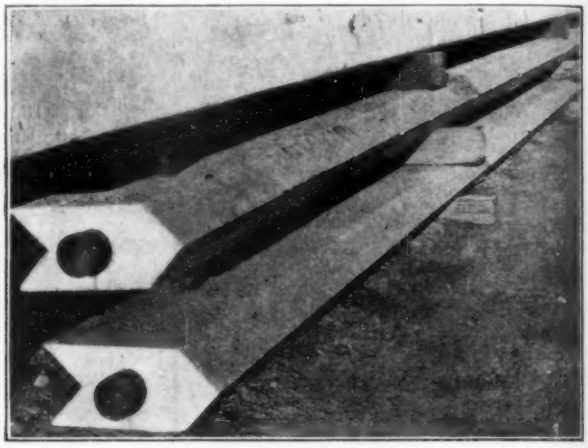
**Preparing to launch one unit of a current retard. It is made up of tree trunks bound together by means of heavy cables. These units are constructed at a convenient point and towed to the place of sinking**

**Launching a retard on the Missouri River. This is done by dragging it off the barge with a cable and steam capstan. Each unit of the retards is attached to pre-cast concrete piles sunk ninety feet upstream**

along a straight line at right angles to the river bank or channel. Each crib is formed of superimposed layers of trees placed with the butts upstream. The trees in each layer are lashed to transverse log skids laid parallel to the axis of the retard. The lashings are one-half-inch wire cables secured by five-inch staples.

Previous to launching the cribs, precast concrete holding piles, 15 to 20 feet long, with attached cables, are sunk at a distance of about 90 feet upstream from the retard site. They are sunk to a depth of 25 to 30 feet below the river bed. The attached cables are fastened to the units of the current retard as they are placed. Some of these retards are more than 500 feet in length and call for a great amount of work in their preparation.

A retard forming accretion land



The pre-cast concrete piles

### Moth-Proofing Solutions Tested By Scientist

CLOTHES moths really do have a hard time chewing up woolen cloth and other fabrics of animal origin that have been impregnated with one of the various mothproofing solutions now in wide use, according to Dr. E. A. Back of the Bureau of entomology of the United States Department of Agriculture. It is misleading, however, to offer an absolute guarantee of protection, he states, and the common method of merely spraying the fabrics confers but little protection. The only way to do the job thoroughly is to wet the cloth through while it is still in the whole piece, and many manufacturers have installed special machinery for this purpose.

One of the favorite and most widely advertised moth-repellants consists of 97 percent of water with 3 percent of sodium aluminum silicon fluoride dissolved in it. Although this solution sells at a very high price under its copyrighted trade name, it really does work, if thoroughly applied. Another newly marketed class of compounds is made up of the cinchona alkaloids, chemically allied to quinine.—*Science Service.*

### It Takes a Year to Cool

THIS month scientists at the Bureau of Standards at Washington will know whether or not they have the largest disk of optical glass ever cast in America.

During the war, when European sources were closed, the Bureau began to make optical glass. Last May these experiments reached a climax with the casting of a disk of glass 70 inches in diameter and 12½ inches thick. This is the largest disk that has ever been cast in the United States, and one of the largest in the world.

But such a disk is not finished when it is cast. Glass conducts heat very poorly. It is very hot when cast, for then it is in a molten condition. If simply exposed to the air as soon as it begins to harden, the outside would cool much more quickly than the interior. In doing so it would shrink, and the result would be that the disk would soon be merely a pile of small pieces of broken glass. Even if cooled more slowly, strains might be set up in the disk that would cause it to crack as soon as efforts were made to grind it into the dish shape of a reflecting telescope mirror.

Accordingly, it is necessary to extend the cooling over a period of many months. In making such a big disk, it is carefully enclosed in sand and fire clay so that it *takes nearly a year to cool.* This is called annealing. By February, 1928, the 70-inch disk at the Bureau will have cooled sufficiently for the scientists to uncover it. Then they will know whether they have a disk or some pieces of broken glass.

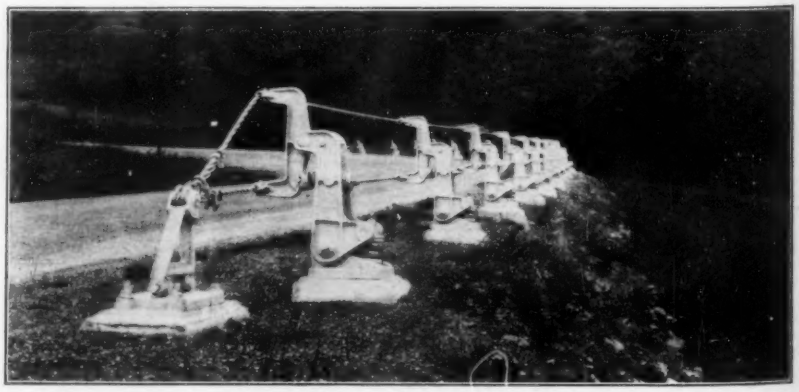
Annealing is not always successful. The largest disk that has ever been cast, from which the 100-inch mirror of the big reflecting telescope at the Mt. Wilson Observatory was made, was completed only after a number of attempts. This was made at St. Gobain, France, where, before the war, the principal factory for large disks was located. Time after time disks were cast, only to find months later that they had cracked in annealing. Even the one finally used was not perfect, as it was cast in three layers, and when completed showed two layers of bubbles, like the filling in a layer cake. So it may be that the glass workers will find in a few months that they have to try again.

Even if the disk comes out of the annealing safely, it is not known what will be done with it. The St. Gobain works were demolished, and many of their most skilled workers killed in the war, so large disks are very hard to obtain. Several American observatories are in the market for big disks for reflecting telescopes, but just how the Bureau's disk could be transferred to one of them is not certain. There are legal difficulties hampering the sale or gift of the glass, and so it might take an act of Congress to dispose of it.

But the Bureau officials are not worrying about this bridge at present. What they are chiefly interested in is whether or not they have the disk.—*Science Service.*

### Resilient Highway Guard-Rail

SOME very interesting results in the development of a mechanical highway guard-rail for the protection of dangerous locations such as usually exist at abrupt turns, steep embankments, bridge approaches, and so on, have recently been accomplished by Joseph H. Ramsey, of Albany, N. Y., in collaboration with Dis-



**Close-up of an installation of the safety guard rail on a sharp curve of a New York State highway. The uprights and arms rotate on bearings and are held in place by spiral springs which take up collision shocks**

trict Number 1 of the New York State Department of Highways.

This safety guard-rail is built around the principle that resilient mechanical means shall be embodied within the cable supports to cushion and absorb the impact resulting from a colliding motor car and that the materials used shall be capable of withstanding terrific stresses.

The guard-rail supports are of malleable iron and comprise bases upon which are pivotally mounted, on cupped bearings, pairs of vertical struts or side plates. These struts support at their upper ends equalizers pivotally mounted on cupped bearings between them. The equalizers are maintained in their normal positions by pairs of compression springs located between the vertical struts. The struts are wider apart at the bottom to effect proper side-bracing and are maintained in their normally vertical positions against the action of heavy compression springs at the rear of the bases.

Upon the facing portion of the equalizers are two brackets projecting toward the highway, upon the ends of which the cables are freely suspended by U-shaped stirrups.

The ends of the cables are passed around sheaves in malleable iron brackets which are hinged to base castings upon concrete foundations.

The malleable iron castings with their cupped bearings and cushioning springs comprise a support for the cables of maximum resilience and strength, and are mounted upon suitable concrete piers.

When a motor car collides with the guard-rail, the equalizers at first automatically adjust themselves to distribute the impact equally upon the two cables, thus engaging the maximum supporting surface upon the car. By so directing and cushioning the forces of impact, the damage to the motor car, its occupants and the guard-rail, is reduced to a minimum.

## Motorbus Looks Like Street Car

FRANK R. FAGEOL, designer of motor coaches, has perfected and placed on the market a wholly new type of coach.

The machine is not unlike a street car in appearance, both the front and rear ends being alike, and the familiar "hood" has entirely disappeared. The motive power of the "twin coach," as it is called, consists of two 50 horsepower, six-cylinder engines which are placed amidships on opposite sides of the body and under two seats which are parallel with the sides.

All four wheels are equipped with metal-to-metal, Westinghouse air brakes for service use. The emergency brakes are of the drive-shaft type, one being on each of the two drive shafts. This gives three complete and independent sets of brakes.

Each motor drives its corresponding rear wheel, and each is a complete unit, although operated by the driver under a system of single control. Motor speed is automatically synchronized by the fact that the rear wheels must operate at the same speed, and horsepower developed is synchronized for all practical purposes by twin foot throttles. A slight variation in power does not affect the efficiency.

In this design, much of the disadvantage of wear from road strains and shocks has been overcome as the stress is distributed over the entire floor area of the coach instead of being limited to a small section before and behind the cowl as is the case with the type of coach in use at present.

Flexibility has been achieved through even weight distribution and this is said further to cut down depreciation.

Another factor of interest is the increase in passenger capacity with a corresponding decrease in weight per passenger. The "Twin Coach" will seat 43 persons, an increase of 40 to 50 percent, without additional weight in the body of the coach.

The framework of the body consists of two main channel beams running full length and serving as the "backbone" of the whole coach. Body and chassis are built as one complete unit on these two main channels and the entire structure is mounted directly on both front and rear axles through springs. The wheels are set six and a half feet from the ends of the coach, giving a wheelbase of 208 inches for the machine, which is 31½ feet long.

Economy of operation is claimed for the "Twin Coach," as well as longer wear. The division of the pull between two motors instead of concentration on one is an important factor. It is to be noted that in case of a breakdown of one of the engines, the coach can continue under the motive power of the other.

The "Twin Coach," it is said, involves no new features, the entire design being merely a new application of proved mechanical principles.

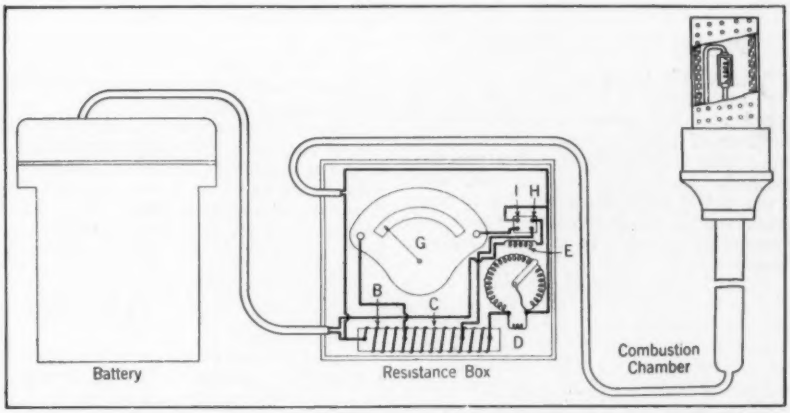


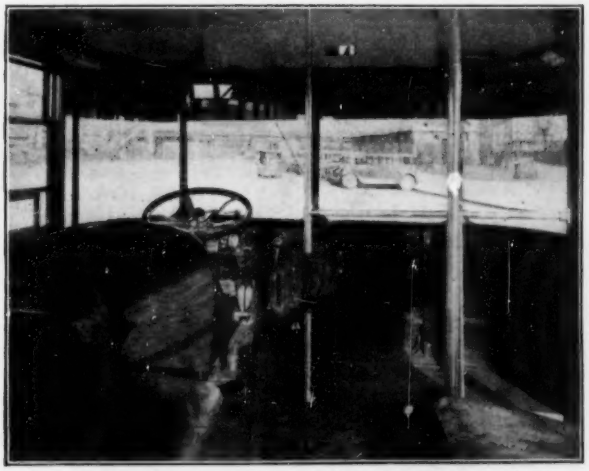

**Diagram of the portable methane detector for mines. The battery and indicator are carried on the belt, and the wires may be extended as desired**

## New Device Detects Mine Gases That Cause Deadly Explosions

A RECENTLY invented electrical detector of "fire damp" or methane, the combustible gas which is responsbile for coal mine explosions, is expected by

(*Continued on page* 180)

**The similarity of this new bus to a street car may be seen from this picture. Access to the motors on either side is through the ports shown**



**View of the interior of the new coach, giving an idea of its roominess and provision for clear vision for the operator. Note concentration of controls**

# Learning to Use Our Wings

## *This Department Will Keep Our Readers Informed of the Latest Facts About Airplanes and Airships*

CONDUCTED BY ALEXANDER KLEMIN
*In charge, Daniel Guggenheim School of Aeronautics, New York City*

### Playing With the Airstream

ONE of the great problems of modern aeronautics is to secure low landing speed and low get-away speed without sacrifice of performance. Increasing the wing area indefinitely is not a practical method. Low wing loading and large areas entail large machines for a given gross weight, low in maximum speed, and susceptible to gusts to an uncomfortable degree

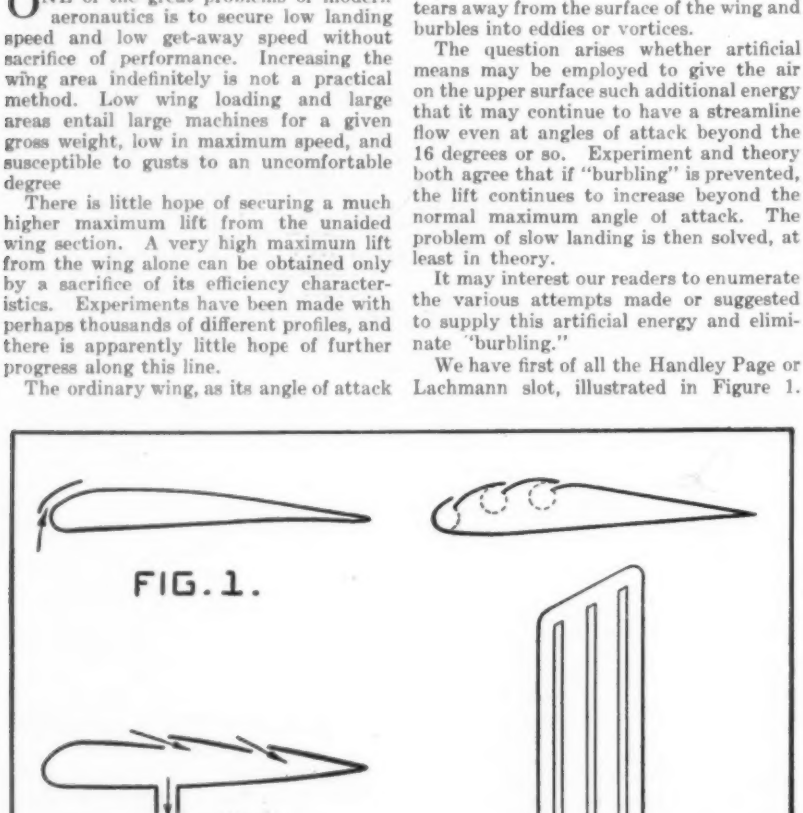
There is little hope of securing a much higher maximum lift from the unaided wing section. A very high maximum lift from the wing alone can be obtained only by a sacrifice of its efficiency characteristics. Experiments have been made with perhaps thousands of different profiles, and there is apparently little hope of further progress along this line.

The ordinary wing, as its angle of attack to the wind increases, increases its lift coefficient. This increase does not continue indefinitely. At somewhere round 16 degrees of attack to the wind, "burbling" begins, and the lift diminishes if the angle of attack is still further increased. When the "burbling" point is reached, the air on the upper surface of the wing no longer flows in streamline fashion. It loses so much of the energy it had at the leading edge that it "cannot make the grade," tears away from the surface of the wing and burbles into eddies or vortices.

The question arises whether artificial means may be employed to give the air on the upper surface such additional energy that it may continue to have a streamline flow even at angles of attack beyond the 16 degrees or so. Experiment and theory both agree that if "burbling" is prevented, the lift continues to increase beyond the normal maximum angle of attack. The problem of slow landing is then solved, at least in theory.

It may interest our readers to enumerate the various attempts made or suggested to supply this artificial energy and eliminate "burbling."

We have first of all the Handley Page or Lachmann slot, illustrated in Figure 1. When the slot is opened, air passes with additional energy through the slot from the lower to the upper surface. Experiments have shown that an increase in lift coefficient of nearly 100 percent is possible (although only with wings having by themselves a low maximum lift capacity). The Handley Page or Lachmann slot has been applied to actual airplanes with success. Its wider adoption is a matter of the mechanical complexities its use involves, of the objections that constructors and pilots have to the use of "gadgets," and of doubts as to its mechanical reliability in rough service.




**Four sections of experimental wings to give a better slipstream. Figure four shows both section and plan of a suggested form. See text at right**

Another line of attack is *absaugung* as the Germans term it. The principle of this method is illustrated in Figure 2, diagramatically. A ventilator or fan is connected to the hollow interior of the wing. Air is sucked away from the upper surface of the wing, and there is no doubt that this is also a highly effective method of maintaining streamline flow and increasing lift beyond the customary "burbling" point. Very high lift co-efficients have been obtained by this method. It is also claimed that the expenditure of power in the ventilator is very small, and that efficiency actually can be increased at ordinary angles of flight.

Another plan is suggested by a patent of E. C. A. Baumann, of Stuttgart, Germany. As shown in Figure 3, a shutter on the underside captures all the energy of the air and the air flows through the hollow wing to a slot in the upper surface, producing the effects previously described. We know of no experimental data on this idea, but it is at least of interest.

Yet another suggestion made in several quarters is to supply the interior of the hollow wing with air under pressure. Baumann suggests this method in another patent, which is again illustrated diagramatically in Figure 4. Austrian experiments have been made with a similar system. The indications are however that more power has to be applied where a pressure system is employed than where *absaugung* or sucking away is the principle.

Wherever artificial means are employed, such as sucking away or blowing, an auxiliary power source must be provided, whether in the form of an auxiliary gas engine, an electric motor driven by storage batteries, or a wind-driven turbine. These must be small, of light weight, and absolutely reliable. The ordinary source of power of the aircraft cannot be relied upon, since it is when the engine fails that such devices reach their maximum usefulness.

The development of all these principles requires much work in the wind tunnel, and the careful study of the structural and mechanical details.

It cannot be said that the developments are unpromising, on the contrary they deserve the most careful attention on the part of our scientists and inventors.

### Astronomical Navigation

IN overseas navigation, reliance cannot be placed solely on the earth inductor compass, and radio signalling is not in itself sufficient as a means of position finding. As Commander Byrd, a seaman, fully realized,

there must be means of making astronomical observations. Victor E. Carbonara, in a paper on "Aircraft Instruments for Oversea Navigation," read before the Society of Automotive Engineers, substantiates this view, and describes the instruments and methods for use by the aviator.

Where celestial bodies are visible, the sextant and the chronometer, having a total weight well under five pounds, represent the most effective equipment for position finding with tolerable accuracy. Modern methods of astronomical navigation are indeed so expeditious that position finding with sufficient accuracy should not take more than 10 to 15 minutes. It is true that this involves some simple trigonometrical calculations, but the necessary operations can be learned by rule of thumb in a short time, and extremely simple tables are available.

The sextant is a portable instrument for measuring angles. The angle with which we are concerned in astronomical navigation is that subtended between a celestial object and the horizontal to the eye of the observer. To a sea-going navigator, the horizontal is represented by the sea horizon, to which a small correction must be applied depending upon the elevation of the eye above the sea level. As the height of the eye increases, the correction increases and with it, the radius of the visible horizon is lengthened. The horizon loses definition very rapidly as the airplane rises, even in clear weather, and on most occasions the sky blends with the sea without showing a definite parting line.

The natural horizon cannot therefore be relied upon for aircraft observations. Artificial horizons must be supplied by such devices as a bubble level, a simple pendulum or a gyroscopic pendulum.

The bubble-level type of artificial horizon seems to be the best. It is light, compact, well damped and accurate. Acceleration of the airplane will disturb any gravity-controlled apparatus. The bubble level will also be disturbed by the turning, pitching and varying speed of the airplane. The magnitude of the consequent errors depends very largely on the skill of the pilot and on that of the observer. But by a series of four quick observations, Mr. Carbonara thinks that errors of more than 35 miles can be avoided, which is very small indeed when long-distance oversea flights are considered. It was only because he struck an unusual condition of continuous fog and cloud that Commander Byrd finally lost his bearings when over France.

## The Curtiss Helicopter

THE Board of Directors of the Curtiss Airplane Company have recently voted a sum of 75,000 dollars for the experimental development of a helicopter. The newspaper accounts are somewhat conflicting and were apparently quite unauthorized. We can only speculate on the exact characteristics of the craft.

There are apparently four blades or wings, revolving in a horizontal plane about a central vertical axis, thus far resembling the La Cierva Autogiro. In the Autogiro, an ordinary airplane propeller pulls the craft forward, and the blades revolve solely under the action of the blast of air produced by the forward motion. In the Curtiss helicopter, on the other hand, a small air-cooled engine, between 50 and 75 horsepower, is placed at the center point of each blade; the engine drives a propeller, whose thrust pulls the blades around. Thus revolution of the blades is secured by direct application of mechanical power, but without the use of any gearing, lengthy transmission shafting or clutches as in many previous forms of the helicopter. A distinct advantage in simplicity is gained thereby.

With a wing spread of 35 to 40 feet, and total engine horsepower of 300, there will be no great difficulty in securing vertical lift and rapid vertical climb, although the 1900 feet a minute mentioned by the newspapers seems somewhat optimistic.

Presumably forward motion will be secured by nosing the craft down, so that the thrust of the airscrews has a forward component.

The blades, when revolving with side movement, meet the wind rather faster when going into the wind than when moving away from it. This introduces a difficulty in lateral stability, the wing going into the wind producing a greater lift than the one going away from it. La Cierva met the difficulty by having his blades free to swing up and down. In the Curtiss helicopter, it may be necessary to provide some form of cam motion for the blades, diminishing or increasing the angle of incidence at appropriate points on the circular path.

There are of course serious problems in control involved in this new design. The reliability of the engines and of the gasoline system when swung around at the end of a long arm is a point requiring careful thought.

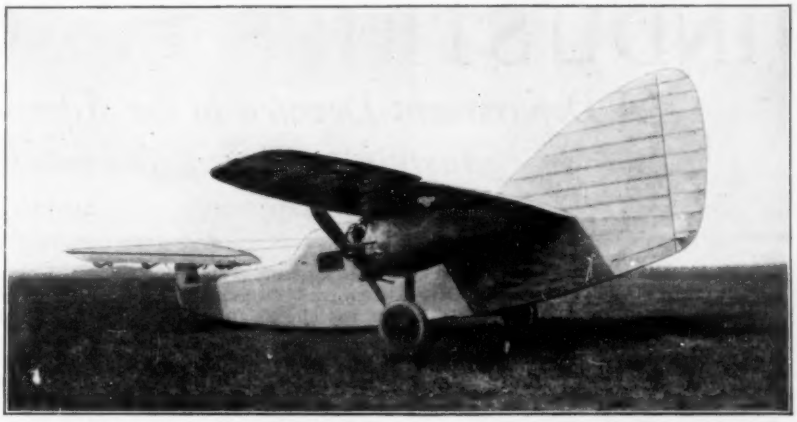
The question of efficiency in forward flight is also a difficult one. No rotating element used to give sustention is likely to be as efficient, in forward flight, as a fixed airfoil. The driving propellers will be subjected to peculiar conditions, the air striking them sometimes head on, sometimes from the side.

But perhaps a great forward speed is not contemplated. The function of the helicopter is to rise from a roof, and to fly to the nearest landing field. A relatively slow forward speed would make it a valuable auxiliary to air transport.

## The Focke-Wulf "Duck"

THE German Focke-Wulf Company have brought out an interesting new plane, the "Ente" or "Duck," which apparently reverts to the early practice of the Wright Brothers in having the horizontal stabilizer and elevator ahead of the plane, instead of being placed at the tail as is standard practice today. The rudder and fin are disposed at the rear as in a conventional design. Safety is the main consideration of the airplane designer of today, and the Focke-Wulf Company have the improvement of aerodynamic safety in view in their new design.

When a plane meets the air at too high an angle of incidence, it is likely to "stall." The lift drops off abruptly, control is lost in a large measure, and there is danger of a spinning nose dive. The proper maneuver when approaching a "stall" is to nose down. It is claimed for the "Ente" that this is just what it will do automatically.



**The Focke-Wulf "Duck." Reverting to early practice, the tail surfaces are placed ahead of main wing. This arrangement helps prevent stalling**

The horizontal surfaces when placed ahead of the center of gravity must carry an appreciable up-load to maintain balance, since the lift on the main planes is behind the center of gravity and tends to nose the machine down. Therefore the horizontal surfaces are placed at a larger angle of incidence to the air than the main planes. When, through an error of the aviator, a gust of wind or some other reason, the craft is approaching the "stalling" point, the tail surfaces, being at a larger angle of incidence, "stall" first. They then lose lift, the balance is broken, and the machine automatically noses down until a normal, safe flight attitude is recovered.

Tests in flight seem to substantiate this theory, as do the exhaustive wind-tunnel experiments.

Another advantage of the "Ente" machine is that the wheels are so far behind the forward end of the craft. No matter how bad the landing, it is almost impossible to conceive of the craft turning over on its nose, pivoting about the wheels as an axis as often happens with ordinary airplanes.

It may be asked why the vertical rear fin is of such huge proportions. A plane to be directionally stable must have a preponderance of lateral area behind the center of gravity. When a side gust strikes the plane, it then heads into the wind, without any danger of spinning. In the "Ente" there is naturally a good deal of lateral area forward of the center of gravity. Accordingly a great fin area aft is needed to retain for the craft its "weathercock" stability.

The "Ente" is in many other respects an excellent design. Thus the engine nacelles fit nicely into the lower surface of the wing, as may be seen above.

# INDUSTRIES FROM ATOMS

## *A Department Devoted to the Advancements Made in Industrial and Experimental Chemistry*

CONDUCTED BY D. H. KILLEFFER

### Preventing Lime Deposits in Water Mains

THE addition of lime to water supplies to reduce hardness often results in a high enough concentration of calcium carbonate in the water to cause deposits of it to form in water mains. To obviate this difficulty, Charles P. Hoover, of the Water Softening and Purification Works, Columbus, Ohio, recently proposed at a meeting of the American Chemical Society to add carbon dioxide to the softened water. In this way the tendency to deposit crystals of calcium carbonate is greatly reduced. Mr. Hoover suggests the following procedure:

"The recarbonation of water requires apparatus which must be largely automatic, continuous, and requiring a minimum of attention. Such apparatus consists principally of a combustion chamber so designed as to permit nearly theoretical admixture of air and fuel; a washer or scrubber where the products of combustion are cleaned and cooled to about atmospheric temperature; a drier for removing the water that may come over mechanically with the gas; a compressor or blower equipment for raising the pressure to an amount that the hydrostatic head in the recarbonation chambers will be overcome; and lastly, recarbonation basins provided with gas diffusers for uniformly diffusing the gas into the water. We are concerned with the number of pounds of carbon dioxide absorbed by the water, and therefore accessory to the carbon dioxide plant must be gages, instruments, and other devices which will enable the operator to know just what he is doing. The proposition is largely volumetric, and in larger plants at least, recording gages registering the total amount of carbon dioxide that has been delivered to the water over any period of time should be provided."

### New Solders Suggested

FROM a careful study of the surface tensions of molten metals, A. W. Coffman and S. W. Parr, of the University of Illinois, have concluded that an alloy of thallium and bismuth or of thallium and antimony might make a better solder than those now in use. They suggest that it might be possible to produce better solders by alloying metals having widely different surface tensions and atomic volumes. No application of their ideas has yet been made.

### Fluxes For Soft Soldering

"WHY does a flux assist soldering?" was the question which R. S. Dean and R. V. Wilson of the manufacturing development branch, Western Electric Company (Chicago), set for themselves in a study recently published in *Industrial and Engineering Chemistry*. They carefully measured the spreading of soft solder on copper surfaces and reported their conclusions in part as follows:

"From a consideration of the results it was possible to define clearly the requirements of a good soldering flux which would be truly non-corrosive and yet be as effective as the metallic chlorides now in use. Such a flux should be insoluble in water (incapable of hydrolysis), should at soldering temperatures (approximately 200 degrees, Centigrade) liberate an acid gas and leave as reaction products no compounds which are themselves corrosive or a hindrance to solder flow. Such a compound might be expected to be found among the halogenated hydrocarbons, such as hexabromoethane and dibromoanthracene tetrabromide, of sufficiently high molecular weight to be insoluble in water. Naphthalene tetrachloride has been found quite satisfactory for certain types of commercial work and is now in use. This flux, however, gives off hydrochloric acid at low enough temperatures so that it is condensed by the moisture on the metal surrounding the soldered joint and a litmus paper test reveals a slight acid

(*Continued on page* 170)

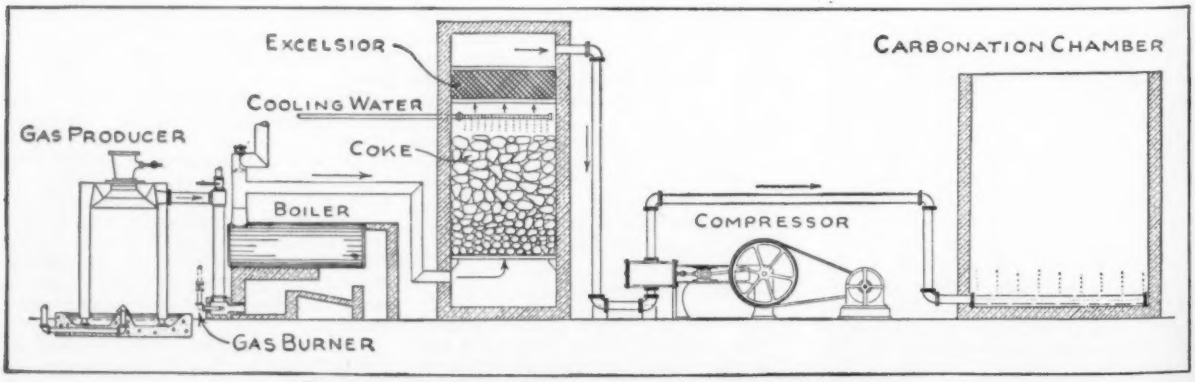
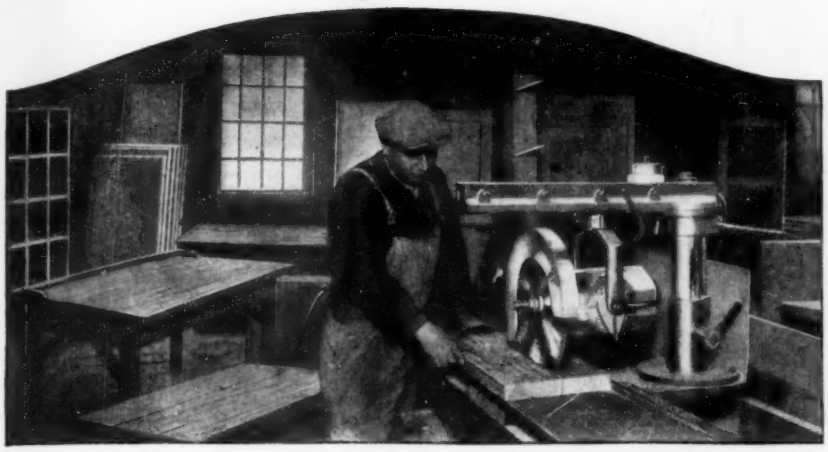



**Diagram of the Water Recarbonation Plant at Columbus, Ohio**



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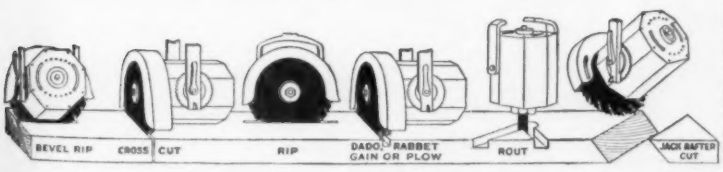


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# Strays From the Ether

## *A Monthly Review of the Progress Made In All Branches of Radio Communication*

CONDUCTED BY ORRIN E. DUNLAP, Jr.

### Opportunity Knocks!

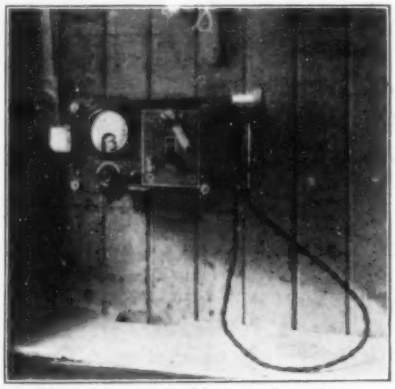
MALCOLM P. HANSON, naval radio engineer who designed the radio apparatus on Byrd's polar and trans-Atlantic flights recently said that he believes the day is rapidly approaching when skill in radio operating will be recognized as a material asset to both pilots and mechanics, and that such men will be in considerable demand at an increased rate of compensation. This field of activity should offer special inducements to radio amateurs, many of whom, besides being proficient in radio operation and construction, are gifted mechanics. Much of our future aviation personnel, both military and commercial, will be recruited from their ranks, with resultant inevitable benefit to aircraft communication, efficiency, and safety.

Young men of this experience who obtain a thorough knowledge of aircraft engines and mechanisms and learn their intricate adjustments should find a remunerative and interesting field of employment as aircraft radio-mechanics, with frequent opportunity to assist the pilots in handling of the planes and eventually qualifying as licensed pilots themselves. Such pilots familiar with the mysteries of radio and understanding every detail and peculiarity of their engines, will make a name for themselves in commercial aviation, and will help to reap new laurels in safe and efficient long-distance flying.

### Antenna Pointers

A BULLETIN called "Antenna Pointers" has been issued by the Fada Radio explaining how to get the most out of various types of antennae. The contention is that a great many antennae are improperly erected and therefore the best of reception is not enjoyed by the radio set owner.

"The ground lead should be as short as possible and should be firmly connected, preferably soldered to a cold-water pipe or steam radiator pipe," advises the bulletin. "An iron pipe driven into moist earth directly outside of the window nearest the receiver can in many cases be utilized as a good ground contact. Furthermore, it is preferable to use a continuous piece of wire as the antenna and lead-in without splices. The wire should be kept as far as possible from tin roofs, metal pipes, other wires and metal gutters. Two of the best antenna materials are seven-strand



**Microphone and control unit in caboose of freight train. See two photographs directly below**

Number 18 phosphor-bronze wire or a Number 18 hard-drawn copper wire.

"If a hole is bored through the window or casing a porcelain tube insulator should project beyond the edge of the casing both inside and outside, according to the fire underwriters regulations. If any joints are made in the wire they should be soldered. If the lead-in or an indoor antenna runs along the moulding, care should be taken that it does not parallel telephone or bell wires. In locations where an outdoor antenna is not feasible, there are two alternatives, either of which usually proves satisfactory. The first is to loosen one of the screws holding the metal plate that covers a floor outlet or wall switch and connect a wire from that point to the antenna binding post on the set. The contact at the plate can be made firm by tightening the screw. This affords an inductive connection to the house-wiring system or else a direct contact to the metal conduit. In many cases it will operate satisfactorily.

"Then there are the regular antenna plugs which plug into the light socket, effecting an antenna connection to the house wiring system but preventing the current from running into the receiver. For distance and best results, the regular outdoor antenna ranging from 60 to 125 feet including the lead-in is recommended."

### Beethoven Popular With Radio Owners

THE musical taste of broadcast listeners in the United States is much higher than is commonly supposed, according to the answers to a questionnaire circulated by the New York Edison Company. The survey discloses Ludwig von Beethoven as the favorite composer and Richard Wagner's Overture to "Tannhauser" as the favorite type of music. The opinions were based upon the Edison hour of music broadcast by WRNY.

Radio auditors numbering 4800 cast a total of 79,800 votes for 50 composers and 18 types of musical composition. Beethoven received 3245 votes. Franz Schubert ranked second with 2971 and Victor Herbert third with 2935. The next in order were Richard Wagner, Felix Mendelssohn, Fritz Kreisler, Franz Liszt and Charles Gounod. Johann Strauss the Vienna waltz master ranked fifteenth.

In order of their preference the first 10 favorite compositions were: Overture to "Tannhauser," by Wagner; "Poet and Peasant" overture, von Suppe; "March Militaire," Schubert; "Fifth Symphony,"

(*Continued on page* 173)

Photographs on this page courtesy General Electric

**Radio equipment designed for use on railroads for communication between engine cab and the caboose**

**Watertight equipment mounted on tender. The brass rod at the left is a part of the simple antenna system**

*Above:* Modern irrigation engineering is transforming great areas to productivity in various sections of Peru.

*Below:* Cargo of International Trucks being transferred by lighter from the steamer Essequibo to the dock at the port of Pimental. The steamer is touching at this port for the first time, with the largest single delivery of trucks ever made in Peru.

# Reclaiming the Desert of Peru

IN the "Olmus Irrigation Project" the government of Peru is promoting the largest piece of public development work ever undertaken in the South American republic. When it is completed, the Olmus Desert, comprising upwards of a million acres, will be made to bloom like the proverbial rose.

Motor Trucks are shouldering a heavy share of the great burden and, as with many another construction project the world around, *the trucks are Internationals.* The Irrigation Commission has chosen to *standardize* on International after trying out many makes of trucks. Fifty-four Internationals—both heavy-duty and speed trucks—have been proving their qualities in many months of the most strenuous hauling.

The matter of service plays its part, too, in the Peruvian preference. International Harvester maintains a world-wide representation that puts trucks on the job speedily, and keeps them there, wherever the job may be. In the United States and Canada 160 Harvester-owned branches serve International owners. If you have a hauling job and want it well handled, let International Trucks and Service work for you.

*The International line includes the ¾-ton Special Delivery; 4 and 6-cylinder Speed Trucks, 1½, 1½ and 2-ton; and Heavy-Duty Trucks, 2½ to 5-ton; Motor Coaches; and McCormick-Deering Industrial Tractors. Folders will be sent on request and the various models may be seen at the nearest display room.*

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# Applied Science for the Amateur

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CONDUCTED BY A. P. PECK

### Twin-Propeller Indoor Pusher Type Model Airplane

**CONTINUING with the publication of the directions for the construction of model airplanes, and items of interest to model builders, we present the following article prepared by the Playground and Recreation Association of America. The publication of this material started with our November, 1927, issue.**

**Let us again extend our offer to publish photographs and short descriptions of model airplanes built by our readers, particularly those that have been constructed by following the directions which we have published. A good snapshot of the plane, and a 100-word description will be sufficient. Send them along!—The Editor**

THE following material is needed for the construction of a twin-pusher model:

Fuselage or frame:
- Two pieces balsa wood 36 inches by one quarter inch by three thirty-seconds of an inch for longitudinals.
- Two pieces bamboo nine and three quarter inches by three thirty-seconds of an inch by one thirty-second of an inch for rear X brace.
- Two pieces bamboo seven and one half inches by three thirty-seconds of an inch by one thirty-second of an inch for middle X brace.
- Two pieces bamboo five and three quarter inches by three thirty-seconds of an inch by one sixty-fourth of an inch for front X brace.
- One piece bamboo one and one half inches by three thirty-seconds of an inch by one sixty-fourth of an inch for front brace.
- Two nail bearings for propellers.
- Six cans or rubber guides.
- One nose hook.

Motors:
- Two propellers seven and one quarter inches in diameter, one inch wide, three quarters of an inch thick.
- Two shafts, plain.
- Two "S" hooks, safety.
- Four Number 16 washers or dress spangles.
- 24 feet of rubber, one eighth inch flat thread.

Wing:
- Two pieces bamboo 25 inches by one sixteenth of an inch for edges.
- Nine pieces bamboo four inches by one sixteenth of an inch by three sixty-fourths of an inch for ribs.
- One piece bamboo seven inches by one sixteenth of an inch by one eighth of an inch for ends.

Elevator:
- One piece bamboo nine inches by one sixteenth of an inch by one sixteenth of an inch for front edge.
- One piece bamboo 18 inches by one sixteenth of an inch by one sixteenth of an inch for rear edge and ends.
- Five pieces bamboo three inches by one sixteenth of an inch by three sixty-fourths of an inch for ribs.

General:
- One quarter yard by one yard sheet of Japanese tissue paper, for covering wing and elevator.
- Ambroid and thread.

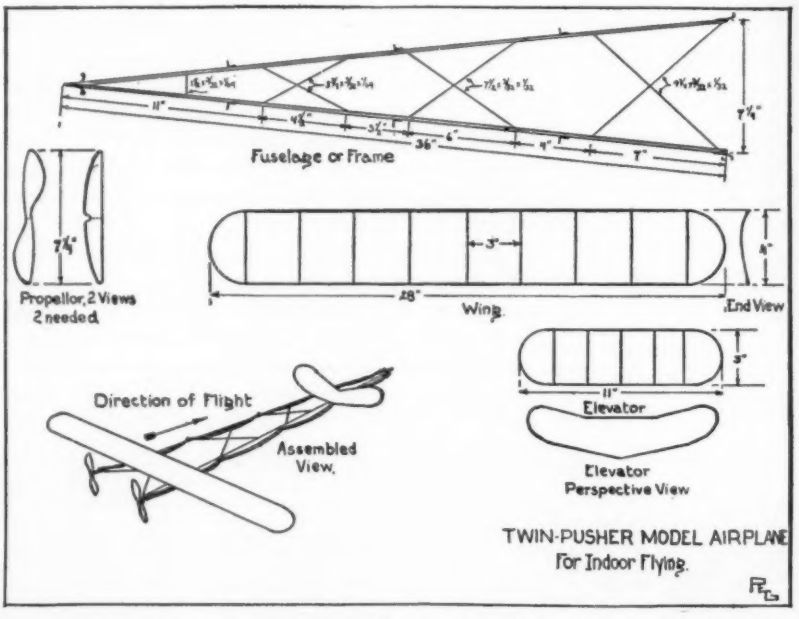
*Construction; Fuselage:* Always in the construction of a wedge shaped or "A" frame, the best procedure is to lay out the shape of the frame full size on a large piece of paper, and lay the material directly over this plan while putting it together. This insures correct placement and true construction. Having done this, cut the front of the two longitudinals into a wedge shape and ambroid them together. The wedges should have such slant that the rear ends will be seven and one quarter inches apart, as shown.

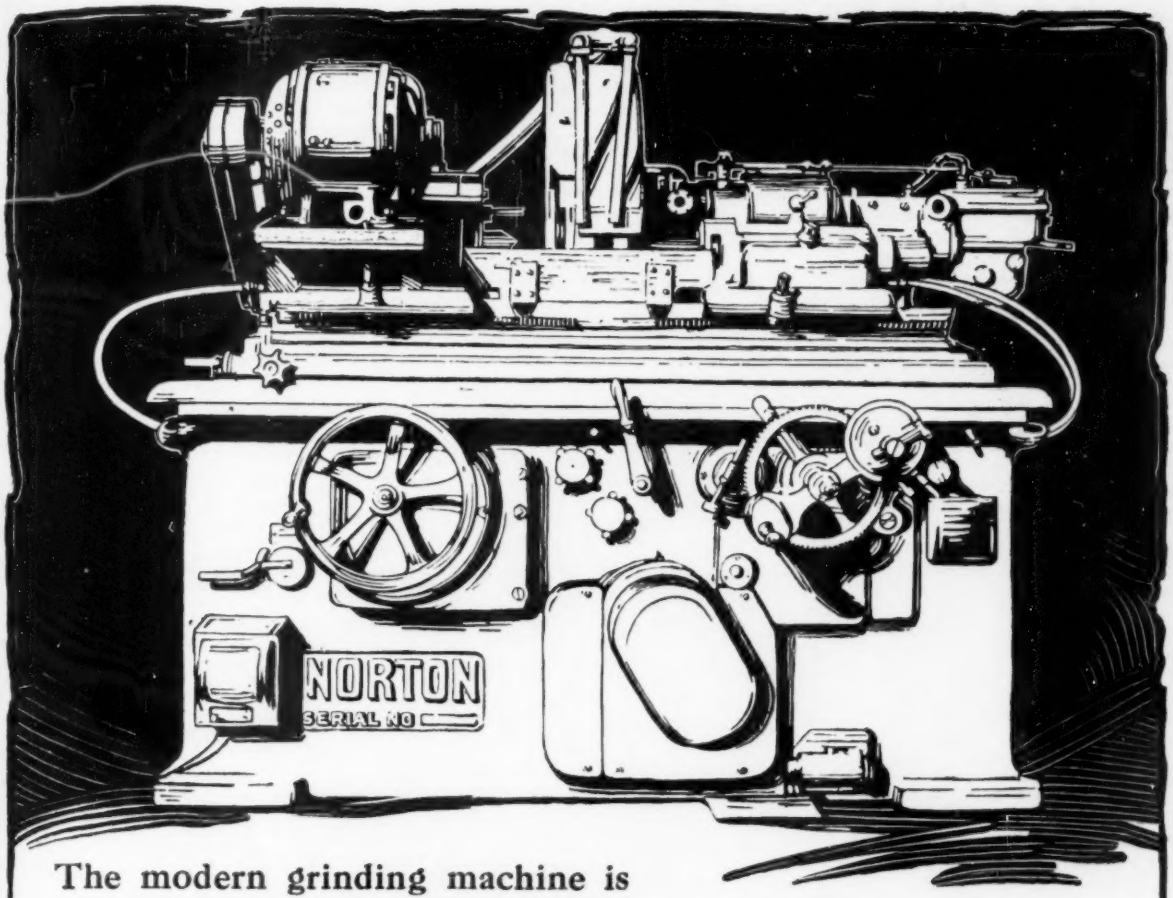
Next bind the nose hook in place. All of the fittings such as nose hook, cans, et cetera, are described in detail in this department in the December issue. Next insert the braces in their proper places as shown on the plan. They are fastened by sharpening their ends to a flat chisel-like point and pushing these points into the side of the longitudinals, and ambroiding in place. The braces should be inserted beginning at the apex and continuing toward the rear. When all are in, line up the fuselage and make sure that the sides are straight. Trim off any portion of the braces which may protrude through the longitudinals and proceed to attach the cans and bearings in their proper places. This frame can be somewhat strengthened by painting it with "dope" or banana oil.

*Motors:* The propellers are cut to the plan and profile shown in our December issue. When finished, the shafts are inserted, and passed through the nail bearings using the washers for reducing friction. The rubber thread is divided into two equal lengths, and each of these looped into four strands, each thirty-six inches long. An "S" hook is fastened in each hank and the rubber is passed through the cans and attached to the propellers, the "S" hooks being fastened to the nose hook.

*Wing:* The nine ribs are bent slightly as shown in the end view of the wing, and their ends slightly split. A ladder-like frame is then constructed by wedging the 25-inch lengths of bamboo in the split ends of the ribs and ambroiding in place. This frame must be true in order to insure good flights. The remaining piece of bamboo is next bent into a semicircle and split in half, forming two identical wing ends.

Bamboo may be bent by holding it in the heat of a small flame and forming it to shape. The two ends are bound and ambroided to the ladder-like frame, and the wing frame is completed. It should next be covered. A piece of paper is cut to larger size than the frame. The frame is painted in the center section with banana oil, and the center of the paper applied, carefully stretching it so as to remove creases. In the same manner each






**The modern grinding machine is giving to the world high production with extreme accuracy.**

The first Norton Grinding Machine, in 1900, carried a wheel two inches wide—a radical change from the ½ inch wheels then in use. Another revolutionary Norton development soon followed—the method of grinding with a wheel the full width of the work in one straight-in-cut. Today wheels as wide as 9 inches are in common use, while the latest Norton machine will accommodate a wheel 15 inches wide.

The increases in production resulting from these Norton machine developments have been sensational. Crankshafts, for instance, which were ground in 1904 in two hours are now ground in from 12 to 15 minutes. Automobile pistons are finished today by Norton machines at the rate of three a minute within limits of accuracy of 1/1000 of an inch (approximately one third the thickness of this page).

NORTON COMPANY WORCESTER, MASS.

# NORTON

Grinding Wheels
Grinding Machines

Refractories-Floor and Stair Tiles

section and the ends are covered. The paper is then trimmed and the "furry" edges sealed with banana oil. Because this wing is so fragile, and on account of the paper being non-porous, no dope need be used on the wing. It is feared that dope might contort the wing out of shape. Always when not in use this wing should be laid on a flat surface in order that it may retain its true shape.

*Elevator:* The short bamboo edge of the elevator is bent to a "V" shape as shown in the perspective view. The longer piece is then bent with a flat section in its center and its ends rounded to form the wing tips. The two pieces should next be ambroided together as shown in the perspective view. The ribs are now curved and inserted in their proper places in the same manner as was used in constructing the wing. This frame is next covered. The reason for having the front and rear edges different is in order that the elevator may present an angle to the line of flight, and thus raise the nose of the model.

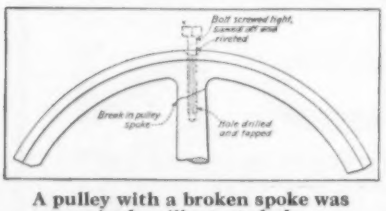
*Assembly:* Fasten the wing and elevator to the fuselage in the same manner as was used for the glider, namely, by use of rubber bands looped under the fuselage sticks and over the wing and elevator surfaces. Adjust the wings to the approximate position shown in the assembled view.

*Flying:* Balance the model by casting it gently forward several times without previously winding the propellers, in order to determine if it glides correctly. If it dives sharply, move the wing or elevator or both slightly forward. If it climbs too rapidly, move the surfaces backward. If the elevator leading edge rests in a wide gap in the fuselage, support the point of the "V" on a small brace so as to raise the leading edge higher than the rear edge. When the model glides evenly, allow an assistant to help you in winding the propellers, having him hold the propellers while you turn the winder, or vice versa. Store about 1000 turns in the rubbers, that is, about 200 turns of the winder, if it has a five to one ratio. To launch, hold the propellers, one in each hand, with the model over the head, and cast gently forward. If the model does not fly well, make adjustments the same way as for the gliding test. For indoor flying it is usually necessary to make the model turn in flight. This is accomplished by moving the wing or elevator slightly to one side.

## Pulley Spoke Repair

Writing in a recent issue of *Engineering and Mining Journal*, Charles Labbe gives the following instructions for a clever repair of a broken pulley spoke:

"The spoke of a large iron pulley was




**A pulley with a broken spoke was repaired as illustrated above**

broken in transit or through casting strains, and in the absence of another pulley it was necessary to repair it, which was done by drilling a five eighths of an inch hole three inches deep and tapping it out to three quarters of an inch at the bottom of the threads. The hole in the rim was countersunk. A three quarter inch bolt was threaded for a length of three inches and screwed in tightly. It was sawed off one sixteenth of an inch above the countersunk portion and the projecting end peened down and filed smooth. After a year of service the pulley was still in satisfactory condition."

## Model of "Spirit of St. Louis"

IN these columns we are publishing the first photograph of a model airplane to arrive in response to our publication of articles on the subject. In the following paragraphs we print excerpts from two letters received from C. Deedera, leader of the Winter Haven Department of Recreation, at Winter Haven, Florida. We thank Mr. Deedera for his interest and are sure that his boys will find much of interest in their study of aviation.

"Enclosed is picture of a replica of the *Spirit of St. Louis* which makes self-rising flights. It has a stick which operates the stabilizer and the pedal bar which operates the rudder. The dimensions are about thirty-nine inches by thirty-nine inches. The lines are slightly molded to suit the exigencies of model flight. There are

**This model of the *Spirit of St. Louis* is described in these columns. It is of the self-rising type, and is an interesting model for constructors to copy**

celluloid windows to facilitate observing the state of the rubber and for opening in case of changing rubbers. The model was made by myself to demonstrate flight requirements in a scientific scale model.

"The club will begin with my 1909 one design model which about 1911 was written up in *Youth's Companion*.

"In my class are 75 school boys much interested in the subject. In our lessons we are enacting the history of aviation and will cover the pioneer developments such as Chanute glider, Langley monoplanes, Wrights' biplanes, Curtiss hydro, Bleriot, Latham's *Antoinette*, et seq.

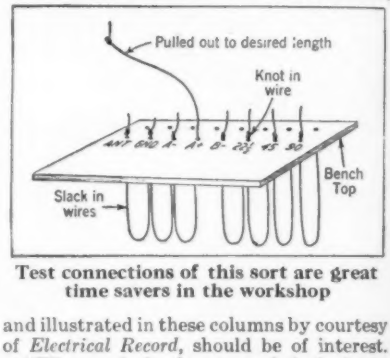
"In the last week in January we are going to have a miniature transatlantic flight for a silver cup which I am presenting for the first amphibian model to fly across Lake Elbert here from point to point—as it has a strait about 300 feet wide. The plane must fly from land to land. It must be self rising and able to support itself on its pontoons or boats should it fail to reach shore, or in any event.

"In flying models we are opposed to hand-launched models because naturally they deceive us as to real practical performance. They do not have the changing center of pressure as in the full-sized machines and I hope to see the day when all contests will require models to use their own power entirely.

"These after-dinner flying mosquitoes should be reserved to adorn fruit cake at banquets and to amuse those who know nothing about aviation."

## Test Connections on Work Bench

Rapid testing of radio sets and the like is an important factor, even in the small shop or the amateur's private workshop. Therefore, the test bench described below,




**Test connections of this sort are great time savers in the workshop**

and illustrated in these columns by courtesy of *Electrical Record*, should be of interest.

"When a dealer has a good deal of test work and repair of radio sets to do it is always advisable to set up a work bench for that special purpose and not depend upon temporary hook-ups which have to be set up each time.

"One dealer had an arrangement of the battery wires which seemed to me to be about as convenient as any. Each wire was of the flexible type and ran through a small hole in the work bench. Each was plainly marked on the bench, such as A minus, A plus, B minus and B plus amplifier and detector. The wires were made long enough so that when connected to the set there would be plenty of slack, thus leaving a loop below the bench.

"After the receiver was all hooked up, it was only necessary to reach under the bench and pull the slack, thus preventing the usual mess of wires in back of the receiver.

"A knot was placed near the end of each wire so that the wire would not pull through the hole when not in use.

"The holes were spaced far enough apart so that there was no danger of a short circuit between the leads when the test bench was not being used. The sketch shows more fully how it was worked out."

# Sore throat while you wait

Working in stuffy quarters, sleeping in over-heated homes, mingling with crowds and using appliances that others constantly use, people run an almost constant risk of a cold or sore throat—or worse.

At the first sign of either, use Listerine, the safe antiseptic, full strength. Gargle with it repeatedly. Rinse your mouth with it. Employ it occasionally as a nasal douche.

This simple precaution may be the means of sparing you a trying—and possibly—a costly and painful siege of illness. In thousands of homes it has checked colds and sore throats before they had a chance to become serious.

Being antiseptic, Listerine immediately attacks the countless disease-producing bacteria that lodge in the nose, mouth, and throat waiting until body resistance is low to strike.

Remember that while you are thus helping Nature ward off disease, you are also putting yourself on the polite side socially, for Listerine, as you know, ends halitosis (unpleasant breath). Lambert Pharmacal Company, St. Louis, Mo., U.S.A.

## Do something about it

THE NEXT TIME!
The next time you buy a dentifrice ask for Listerine Tooth Paste at 25c the large tube. It has halved the tooth paste bill of more than two million people.
More than
50 diseases
have their beginning or development in the throat and nose. Some, of mild character, yield to an antiseptic. Others, more serious, do not. At the first sign of an irritated throat, gargle frequently with Listerine, and if no improvement is shown, consult a physician.

# LISTERINE

*-the safe antiseptic*

"Get the message through"

*An Advertisement of the*
*American Telephone and Telegraph Company*

In the Sixties the "pony express" carried the mail over mountains and Indian wildernesses from St. Joseph, Missouri, to San Francisco. The express riders and station keepers won undying fame for getting the message through, regardless of hardship or danger.

Today, in the city of Denver, there is rising on the site of one of the old pony express corrals another splendid structure dedicated to the service of modern message-bearing—the new headquarters building of one of the companies of the Bell System. In fact and in spirit, the Bell System is the lineal descendant of the pony express.

It is this spirit of responsibility that causes operators to risk their lives by remaining at their switchboards in the face of fire, flood or other great danger. The same spirit calls linemen or repairmen to go out, even at the risk of their lives, to repair the lines in time of accident or storm.

There are no instructions requiring Bell System employees to endanger their lives. It is the spirit of communication that bids them, "Get the message through."

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A NEW BUSINESS in America offers you great chance for Big Profits. As our Representative you will do Big Business making Toys, Novelties, 5 & 10c Store Specialties, Auto Radiator Ornaments, etc. We cooperate in selling goods you make, also buy them from you. An opportunity of a lifetime for the right man to connect with a firm of many years standing. Small investment puts you on road to success. WE FURNISH COMPLETE OUTFITS AND START YOU IN WELL PAYING BUSINESS. NO experience necessary. ACT QUICKLY if you want to handle Big 1928 Wholesale Business and orders now being placed. Write AT ONCE for free catalog and information.
Metal Cast Products Co.
Dept. S 1696 Boston Road, New York

## Industries From Atoms

(*Continued from page* 162)

reaction. A number of other compounds of this type have been prepared which are fairly good fluxes but which offer the same difficulties. The work along this line is being continued and it is thought that a compound giving chlorine rather than hydrogen chloride might be better since chlorine is not so hygroscopic."

### Hydroelectric Fuel

HYDROGEN and oxygen, to be manufactured by the electrolysis of water using the off-peak power of hydroelectric stations, are seriously suggested by A. T. Stuart of 8 Strachan Ave., Toronto, Canada, in a recent article in *Industrial and Engineering Chemistry* as factors of tremendous economic importance in power production and utilization. He says in part:

"Although low-cost oxygen and hydrogen could best be produced in large quantities at the power plant, production might also be effected at any point on the electric transmission system or even on the premises of customer industries. If produced at the power plant, the oxygen and hydrogen could be fully utilized there in various processes, or these gases or gaseous products of manufacture could be distributed in pipe lines over large areas.

"It is not necessary to comment on the uses of hydrogen, especially its use as a constituent of fuel gas. Aside from its use as a fuel, the demand for hydrogen in a more or less pure state is growing enormously and it is estimated that, with the operation of plants now projected, the demand will total over 100 billion cubic feet per year. With the introduction of new processes, such as the Bergius process for the hydrogenation of coal, and the use of hydrogen as a reducing agent for metallic ores, this demand will know no limit, especially when all surplus supplies can be absorbed in gas works.

"The potential uses for oxygen may be divided into two main categories. By the first process it is possible to produce from coal, solid, liquid, and gaseous products containing almost 100 percent of the energy values of the coal consumed. By the second process these products could be burned in atmospheres enriched with oxygen to any desired degree. Thus too, the potential uses for oxygen are likewise unlimited.

"In regard to possible production of oxygen and hydrogen, it is only necessary to remember that water is the raw material and that each one horsepower year can produce 90,000 cubic feet. While the generation and utilization of enormous quantities of these gases would involve no radically new principles, this very circumstance makes the matter the more attractive and raises the question as to why nothing has been done industrially along these lines heretofore."

### Electrolytic Zinc in France

ELECTROLYTIC zinc has been manufactured in France for four or five years, according to the French correspondent of *Industrial and Engineering Chemistry.*

This zinc contains only 0.03 percent of impurities and its use is becoming more and more general, for the manufacture of

alloys, for pure zinc oxide, and for sheet zinc. The rolling of ingots of electrolytic zinc has recently been perfected. There are obtained in this way strips of zinc which may be rolled up. These strips, of a thickness varying between one tenth millimeter and two or three millimeters, may have a width of 10 to 320 millimeters, and may attain a length of 100 meters. Zinc in this form may be put to numerous uses, either in electrical appliances or for building work, since it is less easily attacked by acids than ordinary zinc. Its mechanical properties when used for various purposes are also superior to those of ordinary zinc.

### The American Lacquer Industry

MORE than ten million pounds of nitrocellulose lacquers were made and sold in the United States during the last half of 1926 as compared with less than one million pounds during the whole year of 1922, according to M. J. Callahan of E. I. duPont de Nemours Company speaking before the American Chemical Society recently.

"The phenomenal growth of this industry has created an insatiable demand for various types of solvents which hitherto were quite useless industrially and which were, in consequence, almost unattainable," he said. "The creation of an entirely new industry to meet the demands of another in this manner is a frequent occurrence in the rapidly expanding world of industrial chemistry.

"Probably the existence of large stocks of butanol as a by-product of war time manufacture of acetone had as much to do with the creation of the modern lacquer industry as any other single factor. Important as this particular solvent and its derivatives have been in this development, as long as four years ago plans had been made for the manufacture of other solvents to replace them if for any reason the supply should fail.

"The requirements of the lacquer industry necessitate a dependable supply of solvents and we are fortunate in this country in having a great many research organizations constantly at work discovering new solvents and developing old ones to insure permanency to our now important lacquer industry."

"The new lacquer industry is a characteristic case of modern chemical development," said A. A. Backhaus of the United States Industrial Alcohol Company. "Cotton from the south and wood pulp from Canada through chemical transformation replace linseed oil from Argentine flaxseed, numerous new solvents replace turpentine, and cheap ester gum made from rosin and soft copals are supplying uses that could not be satisfied in oil varnishes except by the hard and very expensive copals from New Zealand, Africa and Australia."

### Alloys to Reduce Corrosion Losses

WE are now passing out of the age of steel and into the age of alloys, according to R. J. McKay of the International Nickel Company, Chairman of the Corrosion Committee of the American Chemical Society, in discussing the role of alloys in the control of corrosion before the Institute of Chemistry of the American Chemical Society.

"Development of new alloys has been


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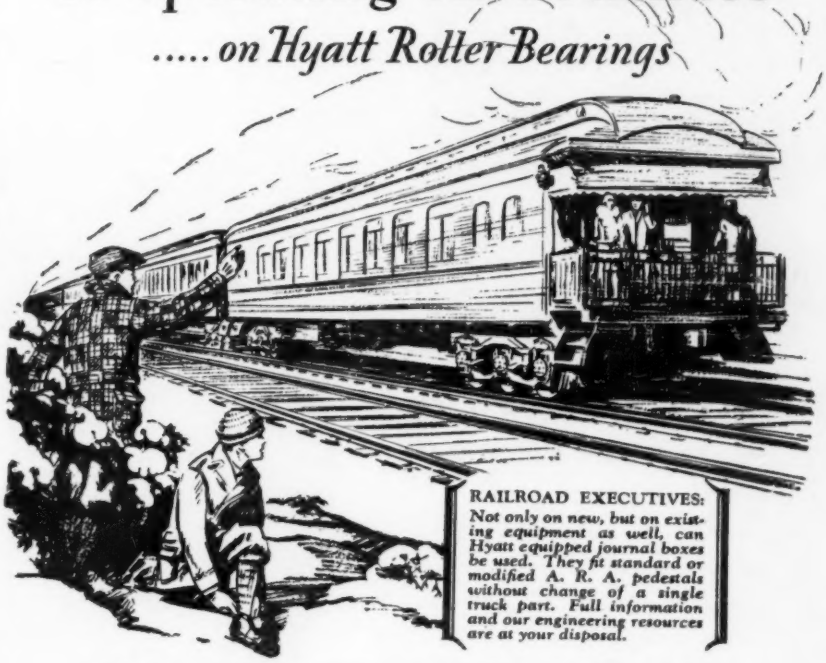

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These trains are rolling on Hyatt Quiet Roller Bearings—the bearings that have played so important a part in the development of the automobile and in the improvement of industrial and agricultural equipment.

Over fifty American railroads, instigating a national movement toward greater passenger comfort, are already operating Hyatt equipped cars.

The operating efficiency and maintenance economy of Hyatt Roller Bearings produce real savings. Harmful friction and wear are eliminated. Desired savings in power, replacement material and labor result.

This, too, is deeply significant to us all because the prosperity of the railroads exercises a tremendous effect upon the prosperity of the entire country.

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Consider possible applications for Plylock in *your* business—this remarkable material which is being so successfully used in many industries.

Take into account its unique qualities—its remarkable width in proportion to length of panels, its laminated construction which makes it proof against warping and splitting, its striking grain pattern. Remember that it is built up of thin rotary-cut sheets of durable Douglas fir, permanently cemented together—that it is comparatively light and tremendously strong, that it is not an expensive material. Standard panels, with unbroken outer grain, may be had as large as 4 ft. wide by 8 ft. long, in various thicknesses.

Plylock is in wide use in the manufacture of automobiles, doors, shelving, cabinets, trunks and cases, toys, meter panels, desks, furniture and wooden novelties.

New uses are constantly being developed. We will gladly send you full size samples for experimental and development work in your own plant, and our research department is at your service.

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**Portland, Oregon**

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Please send me free sample of "Plylock," 3-ply, and your booklet, "The Pictured Story of Plylock."

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impeded by two superstitions now thoroughly exploded. The superstitions that a very small amount of something could be added to steel which would impart to it the durability of copper without effecting its strength or cost seriously, and that something could be added to copper to give the strength and hardness of steel without reducing its durability, have seriously impeded research workers seeking strong, durable alloys. The explosion of these superstitions allows us to proceed with the production of alloys for particular purposes. There will be no more wild chasing after impossibilities since our knowledge of alloys has given us a basis to start.

"The next ten years will probably see the development of more alloys useful in more different ways than have ever been produced before. The light aluminum alloys for aircraft are eminently useful in the conquest of the air, but they are not yet perfect and developments in this line may be expected to be revolutionary."

# The Heavens in February

By PROF. HENRY NORRIS RUSSELL, Ph.D.

At 11 o'clock: Feb. 6.
At 10½ o'clock: Feb. 14.
At 10 o'clock: Feb. 21.

At 9 o'clock: Mar. 7.
At 8½ o'clock: Mar. 15.
At 8 o'clock: Mar. 22.

At 9½ o'clock: March 1.

## NIGHT SKY: FEBRUARY AND MARCH

### The Heavens

At the hour indicated on the map we shall find Gemini and Canis Minor just past the meridian, and Canis Major but a little to the west. Orion is high in the southwest and Taurus in the west; while Auriga, Perseus and Cassiopeia are in the northwest. Draco and Ursa Minor are a little west of north and Ursa Major high in the northeast. Leo is in the east, with Virgo and Bootes rising; and Hydra stretches across the southeastern sky.

### The Planets

Mercury is an evening star until the 24th, when he passes through inferior conjunction and becomes a morning star. He may best be seen at or about the 9th, when he sets a little after 8 P.M. Although in perihelion and unusually near the Sun (only 18 degrees from him) he is for this very reason exceptionally bright, surpassing every star but Sirius, and should be easy to see.

Venus is a morning star in Sagittarius, rising about 5 A.M. and conspicuous, despite her great southern declination. Mars is close to Venus, in fact the two planets are in conjunction on the 14th, Venus being 1° 21′ to the northward. Jupiter is an evening star in Pisces, setting at 8:40 P.M. in the middle of the month. Saturn is a morning star, rising before 3 A.M. Uranus is an evening star a little lower in the sky than Jupiter. Neptune, being in opposition on the 17th, is observable telescopically all night.

The Moon is full at 3 P.M. on the 5th; in her last quarter at 2 P.M. on the 13th; new at 5 A.M. on the 21st; and in her first quarter at 10 P.M. on the 27th. She is nearest the earth on the 24th and farthest off on the 12th. As she sweeps around the zodiac she passes by Neptune on the 6th, Saturn on the 15th, Mars and Venus on the 18th, Mercury on the 21st, Uranus on the 23rd, and Jupiter later on the same day.

## Strays from the Ether

(*Continued from page* 164)

Beethoven; "Unfinished Symphony," Schubert; ballet music from "Faust," Gounod; Meditation from "Thais," Massanet; "Liebesfreud," Kreisler; "H. M. S. Pinafore," Sullivan, and "Nutcracker Suite," by Tschaikowsky.

"One of the significant factors shown in the questionnaire," said Arthur Williams of the Edison Company, "which seems to indicate that the tastes of listeners everywhere are alike, is that the relative positions of the leading composers and compositions were the same for each thousand questionnaires tabulated. Instrumental solos proved to be more popular than vocal solos, with 2720 votes for the former and 1422 for the latter. Radio announcements received their share of comment; 2465 votes indicated a preference for longer descriptive announcements, with but 1740 voting for brief announcements."

### A Fading Dream

THE dream of radio as a means of individual and secret communication between persons or any two desired places on the earth is fading away, according to Dr. J. H. Dellinger, chief of the radio laboratory of the Bureau of Standards.

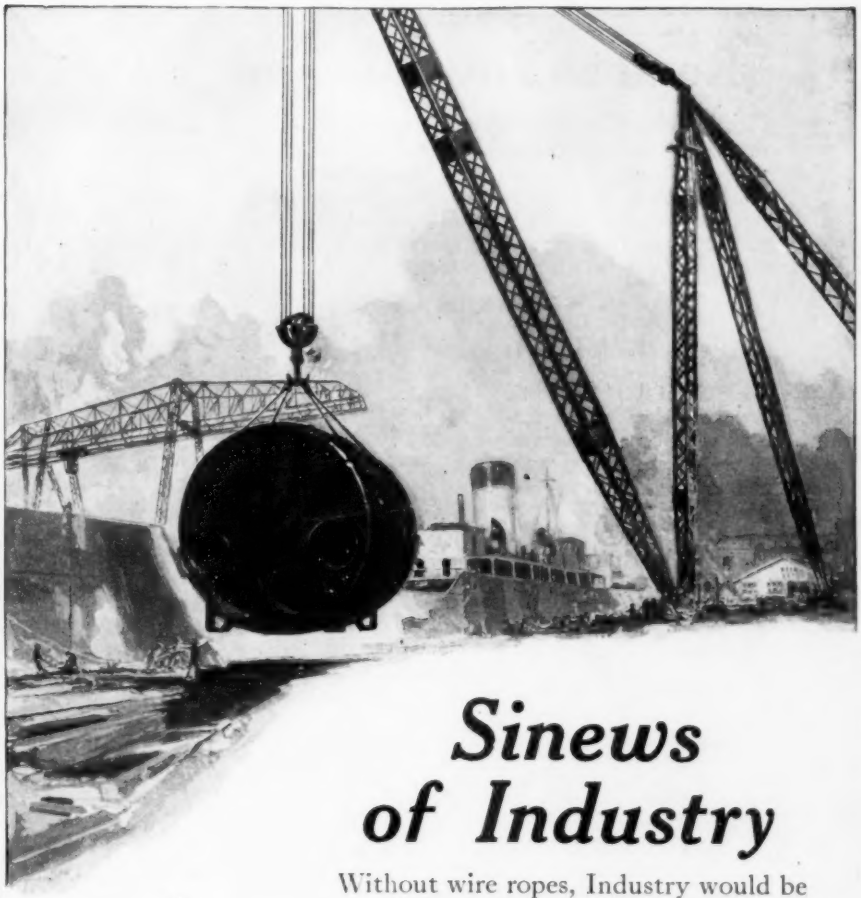
"The directing of radio waves in a very sharply defined beam, like light from a searchlight, is a consummation not likely to be achieved," said Dr. Dellinger. "Nevertheless, the approximations that have been and are being made are of great value. About ten years ago, Marconi demonstrated that, by the use of a parabolic reflecting arrangement, radio waves could be partly directed in a definite direction. With such an arrangement the intensity of the waves along the desired direction was several times that found at angles greater than 30 degrees from that direction."

### Does Cone Loudspeaker Need Wide Surface?

THE cone loudspeaker has generally been adopted as the best surface to use because of its lightness and stiffness, according to Dr. Irving Wolff, radio engineer. However, is it necessary to have a large vibrating surface in order to get good response from the cone-type speaker?

"It is now generally known that a large vibrating surface is the most efficient radiator of low tones," Dr. Wolff explained recently. "Next best we can place a small surface in a fairly large baffle (a surface of non-vibrating material which prevents sound from the back circulating around the front). These facts have created the impression that it is necessary to have a large vibrating surface or baffle, in order to produce low tones. We must not forget, however, that the sound given off by the loudspeaker depends both upon the efficiency of the radiating surface and its amplitude of motion, and that low tones can be obtained even from a small surface by making the motion large. The hope for designing a small loudspeaker with a good response in the low musical range then depends on designing driving motors capable of giving this big amplitude. This is one of the biggest problems which the designer of loudspeakers is now up against.

"That a large surface is not absolutely

# *Sinews of Industry*

Without wire ropes, Industry would be muscle bound—almost helpless.

With wire ropes, the crane, derrick, elevator, donkey engine become *flexible* handling devices of inconceivable value.

For 52 years, Broderick & Bascom Wire Ropes have been serving Industry faithfully and well. Yellow Strand Wire Rope is the highest of all high grade ropes. When developed, 32 years ago, it established a new standard which has never been excelled. The strand painted yellow is your protection.

This company also makes all standard grades of wire rope for all purposes.

**Motorists**
Carry a Basline Autowline in your car and safeguard your spare tire with Powersteel Autolock. Both are made of Yellow Strand. Ask your accessory dealer.

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# Yellow Strand WIRE ROPE

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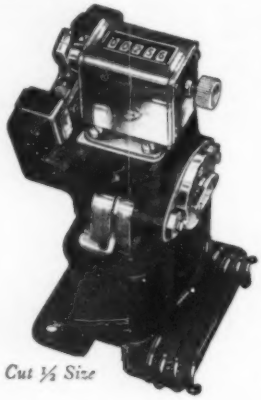
# Read as You Run—or Sit!

Don't take the time to *watch* a machine when a glance at this Counter *tells* the output! Put the Counter where most convenient to read:—over your desk or "banked" with other counters on a Counter-Board. Put the *contacts* where your machine is:—anywhere that connecting wires can be run from machine to counter. This will give you production-records *by wire* directly as work is produced, to "read as you run" or from where you *sit* with an eye on the

## Veeder COUNTER

The "Form US" Magnetic Counter below counts machine operations or units of output, electrically communicated.



*Cut ½ Size*

FOR ALTERNATING CURRENT

Mechanical contacts on your machine make and break the electrical circuit which operates the counter over your desk or alongside other counters on a Counter-Board. The electro-magnetic drive can get its current from your regular lighting circuit: *Alternating current*, either 55, 110 or 220 volts as ordered. Similar model, (Form "UM") for operation by direct current 110 Volts, or by storage battery.

For machines, devices or apparatus where you can't put on a mechanically operated counter, you can readily attach a contact-maker and get your count "over the wires."

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necessary for the reproduction of low notes is apparent from a consideration of musical instruments. The piano is really the only instrument which does have a radiating surface of large dimensions. The organ and bass drum, which produce the lowest notes, have comparatively small surfaces. The human voice may not always be a musical instrument, but even in the worst cases the sound does not come from an aperture of remarkably large extent. These facts should give us hope to try and see what we can do."

### Swarm of Midgets Is Inacceptable

THE broadcasting problem in the United States is a special one inasmuch as the population density in North America is about 16 persons per square mile, and in the United States about 35 persons per square mile, according to Dr. Alfred N. Goldsmith, broadcast engineer. In Europe, on the other hand, the population density is about 123 persons per square mile. He pointed out that it is a much simpler task, in general, to reach highly concentrated populations by broadcasting than sparsely scattered populations. Furthermore, the European problem differs from the American problem in that the area of the average European country is small compared to that of the United States, and problems of international interference and differences of language are factors on the European Continent.

"Considering the organization of broadcasting from a purely theoretical angle for a moment, there might appear to be two widely different methods of supplying program service to the people of the United States," said Dr. Goldsmith.

"The first of these methods may be called the giant central-station method. Essentially, it consists in placing one tremendous station at the geographical center (or perhaps the population center) of the United States, this station being of such extremely high power that, even on the remote seacoasts, the listeners will always get adequate signal strength from it.

"A second and entirely different conceivable system might be termed the 'swarm of midget stations' method. For example, we might have, say 100,000 extremely low-power stations scattered in some more or less logical fashion over the entire United States, each feeding a small portion of the populations with broadcast programs.

"The giant central station method would require excessive power under the present technical limitations of transmission; its service would be interrupted by fading within certain large areas; it would not afford program variety or choice and it would not give uniform service throughout the United States because of the enormous disparity in signal strength from such a station near the center of the country as compared to that near the distant boundaries. The swarm of midget stations method is also inacceptable as a practical proposition."

As Dr. Goldsmith pointed out, such "ideal" methods are out of the question, and the only solution of the problem is through the method of placing a considerable number of normal-power stations throughout the country.

"There are a number of ways in which present or future broadcasters can hold radio listeners and the radio industry," he said. "Increasing the power of stations and

locating stations at points where the radio congestion in the area covered is not excessive, but in places accessible to great telephone systems, thereby enabling the station to be linked up in a network, are important factors in building up a satisfactory system of broadcasting."

### Baritone Voice is Best Test for Loudspeaker

THE popular conception has it that it is harder to record a woman's voice than it is a man's, and that for this reason the fidelity of a loudspeaker in reproducing natural tones is better proved with a woman's voice. But this delusion is no more. Science has investigated the matter, and it has been found that a man's baritone voice is the acid test for accuracy when it comes to proving the quality of a loudspeaker.

Although the range of a soprano voice shows higher fundamentals than that of a baritone, the accompanying harmonics in the man's voice are higher and consequently more difficult to reproduce or record. If these are cut off, the tone is dulled and rounded and loses much of its quality. The corresponding harmonics of a soprano voice are somewhat lower and easier to reproduce. The inference from this, then, is that when the quality of a horn is in doubt, call in a baritone.

### High Power Lauded

"THERE is a tendency to regard any new invention, such as radio broadcasting, as a definite set machine, thus overlooking important future possibilities," said Martin P. Rice, manager of broadcasting for the General Electric Company. "The progress of broadcasting along two systems, namely, wire networks, and superpower stations, indicates the desirability of permitting and encouraging the freest possible growth along both lines. My opinion is that the future broadcasting system will utilize both high-power transmitters and wire networks, but that the science will progress to such a degree that the total number of stations required to serve the public satisfactorily will be considerably reduced."

### Looking Ahead

ANOTHER reader wonders whether it is "a practical possibility to install a radio telephone for personal use in the following manner: a transmitting and receiving set at my house and duplicate equipment in my automobile to cover a desirable range of 25 miles." This man with foresight is a doctor and he probably sees a use for radio in communicating with his office no matter where he may be.

The idea is good but it would be an expensive outlay, especially when a nickel in one of the numerous telephones will connect a doctor with his office. A station license would be required for the transmitter in the home and another for the outfit in the car. The operator at both ends would be required to have operator's licenses. The ignition system of the automobile might cause much interference for the mobile receiver unless the car parked along the highway. The idea is practical—but that is looking ahead to the day when doctors' motorcars are radio equipped.


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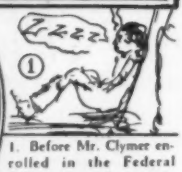


1. Before Mr. Clymer enrolled in the Federal Schools his work was very poor. 2. Note the improvement in his work after Federal Training.

# Compare these DRAWINGS

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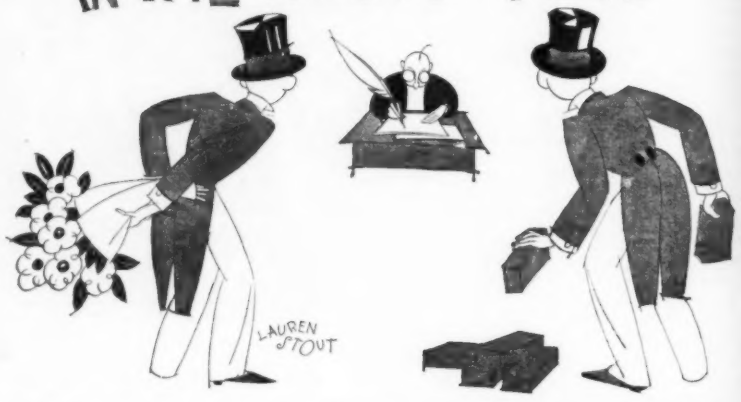
# IN THE EDITOR'S MAIL




## Two More Amateur's Telescopes

AMONG our readers, the interest in telescope making still keeps up. The latest development is the organization of a local amateur telescope-maker's club in the city of Chicago, from names and addresses of the purchasers of the SCIENTIFIC AMERICAN book "Amateur Telescope Making," furnished to a Chicago enthusiast by this journal. We hope to hear more of this ambitious undertaking before long. In the meantime, here are the descriptions of two more jobs performed from the instructions in the book mentioned above:

**Mr. Stonier's piano stool mounting, a good example of the originality the editors have hoped for**

Editor, SCIENTIFIC AMERICAN:

Following out the lines as laid down in your very useful book I have made a crudely mounted but nevertheless efficient instrument.

I procured two pieces of plate glass one inch thick by six inches in diameter, and two pieces of ordinary plate glass three eighths of an inch thick to use as tools. By having on hand two of each, I had a reserve tool and speculum, and this proved to be a good idea, for as I proceeded I found I could obviate on the one the mistakes made on the other.

At present I have a very fairly parabolized mirror. The silvering came quite easy after several attempts.

Wm. J. Stonier.
23 Bond Street, Passaic, New Jersey.

The second letter, that of Mr. Watrous, follows:

Editor, SCIENTIFIC AMERICAN:

I enclose a photograph of my recently finished Newtonian telescope, completed with the aid of your book, "Amateur Telescope Making."

With a magnification of 100 diameters I have observed the rings and one moon of Saturn, Venus in phase and Jupiter with one moon eclipsed.

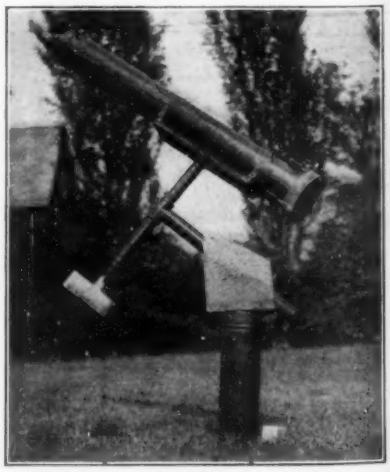
I discovered that it was difficult to produce a well-shaped lap, but that it could be reshaped as often as required, simply by moving it gently over a gas flame.

Robert M. Watrous.
2247 Orrington Ave., Evanston, Illinois.

## Race-track Problem Attracts Wide Attention

IN our issue of November, 1927, on page 470, we published an interesting mathematical problem concerning the design of a peculiar, kite-shaped race-track. Doubtless Mr. John Melhase of Berkeley, California, the proponent of the problem, did not anticipate the receipt of so many solutions. These have been pouring in on him for weeks and they are still arriving.

Whenever we insert in the SCIENTIFIC AMERICAN anything likely to provoke a



**Efficient equatorial mounting made by Mr. Watrous of ordinary pipe fittings mounted in concrete**

reply from our readers we notice a peculiar thing. The replies, instead of reaching us in a mass a few days after publication date as would be expected, keep on coming in for weeks and months. We therefore think the SCIENTIFIC AMERICAN is treasured up and read more carefully than most magazines. Also, its copies are kept on file for years, in public libraries, until they become dog-eared with wear. The thousands of physicians who read the SCIENTIFIC AMERICAN generally place the copies in their waiting rooms where each is read by scores of people. This may account for the long-continued arrival of answers to the race-track problem. As we go to press they are beginning to reach us from Europe, and previous experiences indicate that the returns from South Africa, Japan, South America and Australia will come along shortly.

Mr. Melhase's letter, followed by one of the two solutions he chose, is reproduced below:

Editor, SCIENTIFIC AMERICAN:

Your letter enclosing additional solutions for my race-track problem is at hand. So many replies have come in that I have been fairly swamped with solutions, some quite simple, some unique and ingenious, and some that passeth all understanding.

I wish to take this opportunity to thank the SCIENTIFIC AMERICAN and its many readers who have expended their time and effort in my behalf. Many of those who have submitted solutions have also requested me to send them copies of what I consider the best ones. It is rather a difficult matter to choose the best from the multitude received. They fall into two general groups: the algebraic and the graphic, each of which has its merits. I had hoped to see a purely geometrical solution offered. Some very ingenious ones have been sent in, but unfortunately they were based on faulty propositions.

I am therefore selecting one each from the algebraic and graphic groups and submit them in the hope that they will be published for the benefit of the many who are interested. [Owing to technical difficulties in reproducing the graphs, the graphic solution could not be published. Editor.]

Following is a list of those sending in correct solutions:

Alfred B. Osborne, C. E., Buffalo, New York; John D. Ferry, Rogue River, Oregon; J. V. Spalding, Cambridge, England; R. M. Packard, Counsellor at Law, Boston; C. C. Wylie, Prof. of Astronomy, University of Iowa, Iowa City, Iowa; E. C. Wand, Buffalo, New York; R. F. Arnott, Upper Montclair, New Jersey; W. L. Malone, Tacoma, Washington; G. L. Washington, Greensboro, North Carolina; J. Cherno, Charlotte, North Carolina; A. H. Bachelor, Principal, Lovelock High School, Lovelock, Nevada; F. A. Pearson, Gt. Barrington, Massachusetts; Tracy W. Simpson, Berkeley, California; Don Wirth, Casper, Wyoming; Prof. L. A. Ware, Physics Dept., University of Iowa, Iowa City, Iowa; Roscoe Lamont, Washington, D. C.; Charles Mallinckrodt, St. Louis, Missouri; Martin J. Waclaw, Bethlehem, Pennsylvania; Prof. Marcel DuBois, Dept. of Naval Architecture and Marine Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts; W. H. Elmer, M. D., Rockford, Illinois; L. A. Carenan, Los Angeles, California; Brother Leo, St. Ann's Hermitage, Poughkeepsie, New York.;

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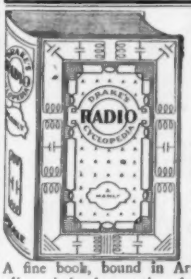


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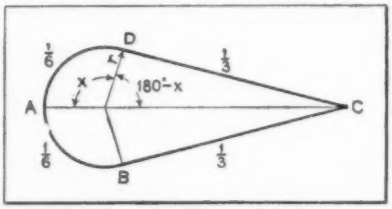
From these answers I have selected the algebraic solution given by Mr. Roscoe Lamont and the graphic solution by Mr. G. L. Washington.

John Melhase.

The correct values are: angle, 15 degrees, 13 minutes, 45.6 seconds; radius, 479.148 feet. Mr. Lamont's letter follows:

Mr. John Melhase,
875 Vincente Ave.,
Berkeley, California.

I noticed in the SCIENTIFIC AMERICAN for Novemeber, 1927, page 470, the problem you submitted of finding the radius of the arc of a kite-shaped




race track one mile around, the two straight sides being one third of a mile each and the arc one third of a mile.

It is an easy matter to get the equation but quite difficult to solve it.

FROM THE DIAGRAM, TAN $(180°-x)=\frac{1}{3r}$ THEREFORE TAN $x=-\frac{1}{3r}$ AND SINCE THE CIRCULAR MEASURE OF AN ANGLE IS THE ARC DIVIDED BY THE RADIUS, $x=\frac{1}{3r}$ AND TAN $x=-2x$. A SOLUTION OF THIS EQUATION WILL GIVE THE VALUE OF x, AND HENCE THE VALUE OF r

TAN x MAY BE EXPRESSED BY A SERIES, AS GOOD A WAY AS ANY BY A CONTINUED FRACTION:

$$\tan x = \frac{x}{1-\frac{x^2}{3-\frac{x^2}{5-\frac{x^2}{7-\frac{x^2}{9}}}}} \text{ AND SO ON.}$$

IF CARRIED FURTHER THAN THIS THE RESULTING EQUATION WILL BE OF TOO HIGH A DEGREE TO SOLVE READILY, BUT THIS ONE WILL GIVE THE RESULT QUITE ACCURATELY. BY RUNNING THIS UP WE GET:

$$\frac{945x-105x^3+x^5}{945x-420x^2+15x^4}=-2x$$

Divide this equation through by x and it will then be in the quadratic form and can be readily solved. x= 1.83665, which is the circular measure of the angle. Reduced to degrees it is 105 degrees, 13.73 minutes. $r=\frac{1}{3x}$: therefore r= .090745 miles=479. feet, 1.6 inches.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This is correct within a tenth of an inch or so. If the continued fraction was carried farther and the resulting equation solved by some of the methods for finding the roots of numerical equations of higher degrees, the value of r could be obtained with more accuracy.

Since tan x=sin x divided by cos x, tan x may be expressed as a continued fraction by dividing the series for sin x by the series for cos x in the usual manner, as explained in continued fractions in any algebra, but it takes reams of paper. There may be other series that might be used which would be more convenient, although I do not know of any.

Roscoe Lamont.

### Yerkes Observatory

A POPULAR brand of soap claims in its advertisements to be 99 and forty-four one-hundredths percent pure. Likewise we do not claim to be infallible. We have a kindly feeling, therefore, toward Mr. Peattie for correcting us on a point of geography so we can let others know.

Editor, SCIENTIFIC AMERICAN:

Your caption writer is shy on geography. In the December issue, he places the Yerkes Observatory "On the west shore of Lake Michigan not far from Chicago." It is located a hundred miles from Lake Michigan on the west shore of Lake Geneva in Wisconsin.

R. B. Peattie,

Tryon, North Carolina.

### A Reader of Scientific American Fifty Years Ago

FROM Connecticut comes the following interesting letter.

Editor, SCIENTIFIC AMERICAN:

The enclosed photograph shows a talking machine made 50 years ago by my father when he was an apprentice in the Stanley Rule and Level Company.

An article appearing in the SCIENTIFIC AMERICAN describing Edison's talking machine was read by my father and he, feeling it would not work, made the reproducer as described, to more fully convince himself, and found that by rubbing his hand over the needle it made various sounds. This induced him to make the rest of the machine with such improvements as putting the reproducer on a swinging arm to make room for pasting on the tinfoil record, and having a one-way thread on the cylinder so it was not necessary to screw back the cylinder each time the record was repeated.

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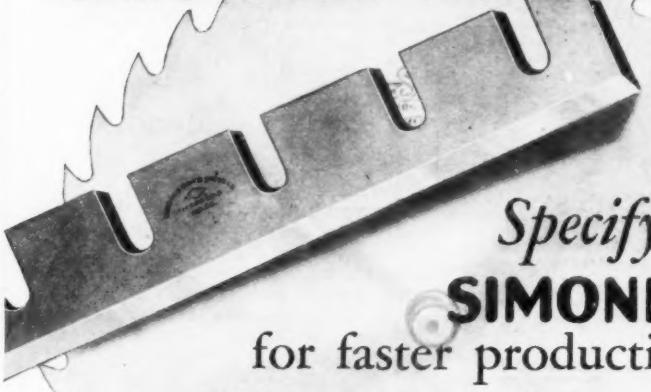

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## The Scientific American Digest

(*Continued from page* 159)

scientists to put an end to much of the loss of human life in coal mine disasters.

Methane, which exudes from some coal measures at unexpected times, is one of the most treacherous problems with which coal mine operators have had to contend. It cannot be smelled and gives no warning of its presence until an explosive mixture builds up. Then a spark struck from a coal cutter or the trolley of a mine's railroad blows every human being into eternity.

The solution of this problem would mean the annual saving throughout the world of literally hundreds of lives and the end of the untold suffering which accompanies such catastrophes.

The new detector, which will probably supplant the inadequate devices which have been used in the past, was developed as a result of research work inaugurated by coal mine operators and state legislators of Utah, who are bending every effort to prevent a recurrence of coal mine explosions in that state.

The Union Carbide and Carbon Corporation offered the services of some of its chemists at its Long Island City Laboratories. Led by Mr. E. K. Judd, this research group assembled various facts which have been known for some number of years and developed an apparatus which detects methane instantaneously, accurately and with extreme simplicity.

A platinum coil is the basis for the detector. Heated to a constant temperature, such a coil becomes slightly hotter in the presence of methane; and the more methane, the hotter the platinum coil gets. This filament, one inch or so long and five thousandths of an inch in diameter, is secured at the end of a stick. It is connected with a portable storage battery which heats it to a constant temperature. The current from the battery is maintained constant by a simple automatic control, so any variation in the heat of the coil is caused by the combustion of methane at the surface of the wire.

The temperature of the coil is then shown on a dial indicator, which is so calibrated to register the amount of methane in the atomsphere around the coil. In order to prevent an explosion starting from the hot coil, it is protected from the surrounding atmosphere by gauze bonnets.

Since it can be attached to a telescopic stick of any length, this sensitive instrument can be poked into the highest crevices on a mine level.

While the indicator registers immediately the presence of an increasing amount of methane in a steady rise of the needle, if there is 5 percent methane in the air (the danger point), the needle will swing back and forth rapidly.

### Airship Gas Source Seen In Atmosphere

HELIUM, the valuable safety gas so much in demand for filling balloons, may be obtainable in unlimited quantities from ordinary air. This optimistic suggestion comes from Dr. Frederick G. Cottrell of the Fixed Nitrogen Laboratory. Dr. Cottrell is one of the country's foremost experts in the chemistry of the atmosphere.

Unfortunately there is but one part of helium in 180,000 of common air. On

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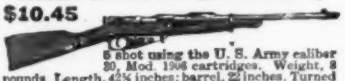

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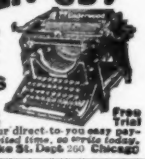

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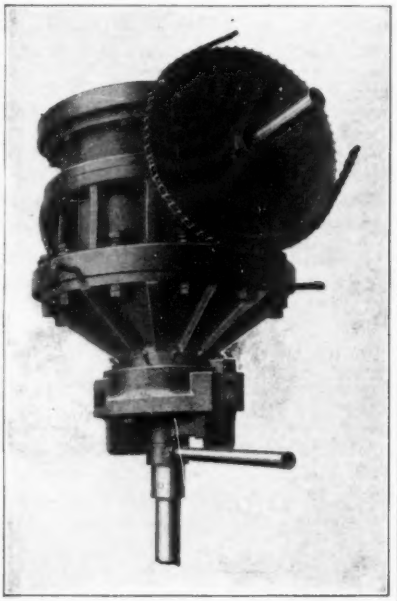
the other hand there is a lot of air. Dr. Cottrell's hopes are based on the prospect of separation of air into its component gases in a large industrial way, whereby the oxygen in particular is to be more efficiently used in combustion. When this sort of wholesale air analysis is undertaken, the helium content of the atmosphere will unquestionably get attention.

It is estimated that some fifty million cubic feet of helium per year go through the blast furnaces of America, along with the enormous volume of air feeding the fires. If it could be salvaged, this quantity of helium alone would revolutionize the airship industry.

Scientists prone to fancy have wished that one might pump down the thin air from the outside of the earth's atmosphere. At many miles distance above the earth's surface it is supposed that the atmosphere is largely hydrogen and helium, the two lightest gases known. From the standpoint of present-day engineering, however, the installation of a stand-pipe to tap these layers would present serious difficulties.—*Science Service.*

## New Method of Clay Pipe Manufacture

IN making extruded clay products by old methods of manufacture, detrimental flaws such as pronounced air cells and irregularly disposed laminations and folds have always been present. By a new method, however, the laminations are of a predetermined character, being transverse rather than longitudinal to the pipe. The resulting product is claimed

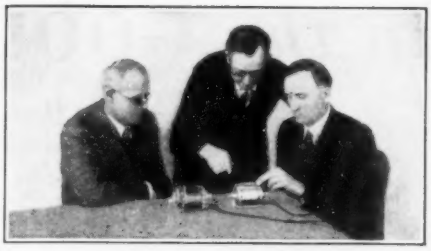


**Exterior of the Alassio clay extruding head, showing the driving mechanism. Details of machine itself have been omitted**

to have a more homogeneous texture and materially increased strength.

This new invention by the five Alassio brothers of Uruguay, South America, concerns solely the extruding head, as the other parts of the machine may be of any approved construction.

The salient feature of the invention consists of one or more arms projecting radially from the center shaft in a plane transverse to the forward feed of the clay through the extruding head. These

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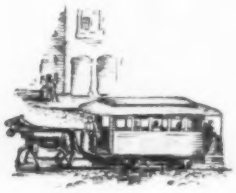

*— when Horse Cars were "rapid transit."*
*— when kerosene provided our "bright lights,"*
*— when even "ma" rode a "bike."*
*— when telephones had to be "cranked,"*

**In those "good old days" you had *time* to read and keep posted. But how about *today?* Read much? No—you don't—you CAN'T—you "don't have time."**

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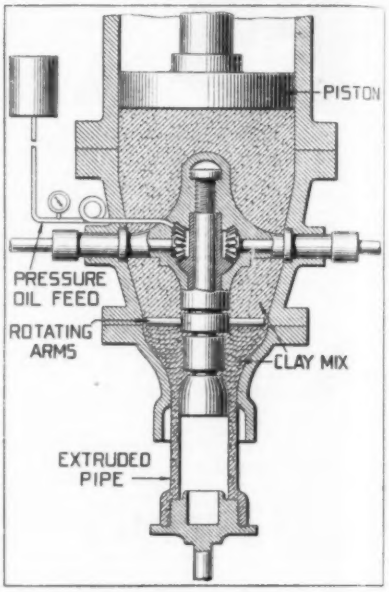
arms rotate through the material at a greater speed than that under which the clay is fed, thus forming very thin, compacted spirals. This laying of definite spiral laminations flattens out any air cells which may be present, and prevents the formation of irregular local laminations and knotty flaws.

Another important feature of this new method is the exclusion of clay from the drive-gear mechanism. The inventors house the bearings in a casing in which oil is kept under a pressure greater than that of the clay. Escape of a small amount of oil into the clay has no deleterious effects.




**This section of the extruding head shows how the clay, pushed by the piston, encounters the rotating arms and is whirled in order to give it spiral laminations**

A public test under factory conditions was made in the plant of the American Vitrified Products Company, representatives of the Mellon Institute of Industrial Research, the Clay Products Association of Chicago, and several large clay product and pipe companies being present. The results obtained, so far as speed of output and appearance of product prior to burning are concerned, are said to have been satisfactory. The 600 to 800 six-inch sewer pipes made during the test were afterwards burned and found to be exceptionally free from flaws.

### Cats Live In Gray World

THIS colorful world of green grass and trees, red meat, brownish-gray mice, and yellow dogs is all just gray to cats. At least, so says Professor F. M. Gregg, of Nebraska Wesleyan University, who has been experimenting with the color sense of night-prowling animals.

In his experiments, the animals were taught to recognize various color combinations. They learned that when certain colors were shown, they could come up and expect to be fed. But when shades of gray corresponding in brightness to the different colors, were substituted for the brilliant rainbow hues, the animals apparently noted no change in the dinner signals.—*Science Service.*

THEODORE ROOSEVELT *said:* *"Bully!"*

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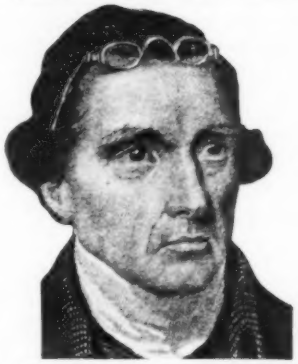

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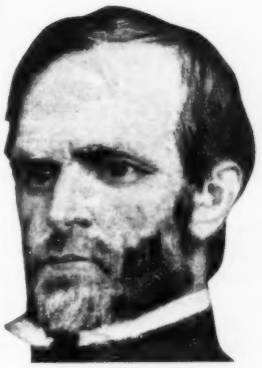

WILLIAM TECUMSEH SHERMAN *said:* *"War is Hell!"*

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# Commercial Property News

## *A Department of Facts and Notes of Interest to Patentees and Owners of Trademark Rights*

CONDUCTED BY MILTON WRIGHT

### The Patent Office Is Falling Behind

LACK of adequate personnel is impairing the efficiency of the Patent Office, Commissioner Robertson points out in his report for the fiscal year to Secretary Hoover. He stresses the necessity of a considerably augmented staff of examiners. Not only is the efficiency of the Patent Office now seriously hampered, but there is a resultant drag on the industries of the country as a whole.

In the fiscal year 1926, the report shows, the average time it took to reach a patent application for first consideration was two and a half months; the average now is three months, and some of the divisions have cases which are six months in arrears. Because of insufficient personnel to handle business, cases awaiting official action have risen to 64,646, an increase of more than 20,000 during the year. With an increase of five new patent divisions in addition to the two which have been authorized for the fiscal year 1928, however, it is believed applications will be acted upon more expeditiously.

Attention is called to the high turnover in the examining corps as a result of the present low scale of salaries. Ninety-eight of the technical and professional force resigned in the fiscal year for this reason.

"To give a professional man, scientifically and legally educated, an intensive training for several years in our particular work and then to have him resign merely because he is paid an insufficient salary is not only false economy but entails large economic loss," declares the Commissioner.

The report shows that in the fiscal year, 113,783 applications were received; 89,360 of these were for patents for inventions, designs and reissues; 24,423 were for trademarks, prints and labels. Fees collected amount to $3,497,132.41, the largest of any year in the history of the Patent Office.

### Carpenters and Free Masons

THE emblem of the United Brotherhood of Carpenters and Joiners is a representation of a partly open carpenter's compass and a partly open workman's rule overlapping the compass. Take a casual glance at it and you might think it the time-honored Masonic emblem consisting of a representation of a square and a compass.

When the labor organization sought to register its emblem in the Patent Office as a trademark to be used in the sale of oranges, grapefruit and tangerines, the Grand Lodge of Free and Accepted Masons of the State of New York successfully opposed it. The opposition went up on appeal to First Assistant Commissioner Kinnan, who summarized the fraternal order's contention as follows:

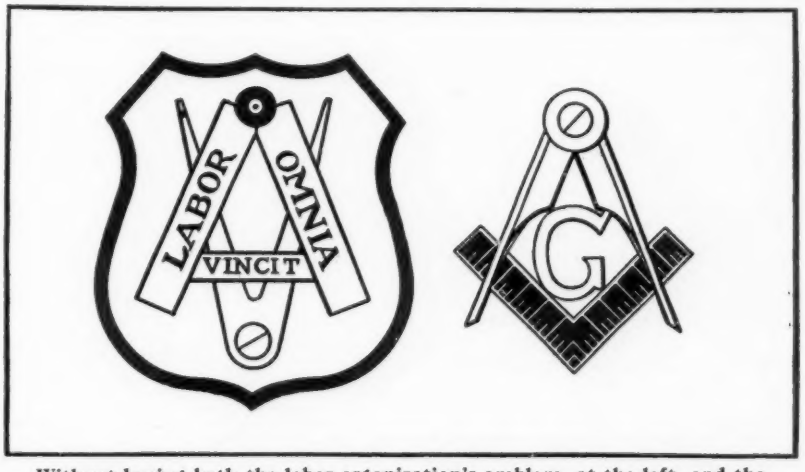
"The opposer is a fraternity widely known and of recognized influence and standing and which has been in existence for centuries. It bases its opposition to registration on the ground that the applicant is not the owner of the mark it seeks to register, that the mark is a simulation and imitation of the widely known and used Masonic emblem consisting of a representation of the square and compass which has been used as the emblem of this ancient fraternal society for at least a century and a half, and that the fraternal society would be damaged by the degradation or undignified use upon goods in commerce of a symbol or emblem so nearly representing that adopted by the opposer society."

The carpenters denied the right of the Masons to sustain the opposition because the fraternal organization is not incorporated, is not the owner of the emblem and finally, the emblem for which registration was sought is so far dissimilar to the Masonic emblem that there is no probability of confusion or mistake in the mind of the public.

The first contention was held to be immaterial. The First Assistant Commissioner held that the two marks are so similar that the average observer, who would not be likely to see the goods side by side, would be confused. The question of ownership he held not to constitute a ground for dismissal of the opposition, the statute providing that any "person who believes he would be damaged by the registration of a mark may oppose the same." Of the damage he said:

"It is believed that the opposer society would clearly be damaged by seeing its emblem, or substantially such emblem, representing as it does, the dignity and prestige of this ancient, honorable and influential body or society, upon a crate of grapefruit offered for sale in a market. Clearly enough, members of that organization would feel that the emblem was being degraded and that members of the public, seeing such emblem upon such goods in trade, would be led to conclude the opposer society controlled or had something to do with the origin or ownership of the goods.

"The fact that other somewhat similar fraternal societies have been permitted to use a similar or the same emblem in the manner and in the way the members of the opposer society use the emblem does not give the applicant company or society the right to use such emblem in commerce. The fact that the applicant company has used its specific mark which it now seeks to register, as an emblem for its fraternal society for many years, without protest from the opposer society, does not give to such applicant fraternity the right to use such emblem as a trademark in commerce. The damage to the opposer society arises from the use of such an emblem as it has adopted, or one similar thereto, in commerce. It is believed the opposer has shown probable damage."




**Without having both the labor organization's emblem, at the left, and the Masonic emblem, at the right, for comparison, confusion is likely to result**

### Apt Advertising's Artful Aid

MERE advertising of a mark or symbol is not enough to establish it as a trademark. You must use a trademark on goods in actual trade before you can claim title to it. Advertising, however, may be highly important in establishing title, for it may be used in evidence to show that the article was on sale.

Such proved to be the case when the Scholl Manufacturing Company, manufacturers of foot corrective appliances, applied for registration of a human foot shown partly within and partly extending through the representation of an annular life preserver. The Jung Arch Brace Company opposed the application, claiming ownership of a trademark, registered in 1922, which disclosed a representation of a circle around a human foot. The Jung Company first adopted and used the trade-

mark in 1919 in its advertising matter.

The Scholl Company sought to establish adoption and use of its mark in 1917. There was no documentary evidence of any sales, but only the memory of witnesses. It did, however, have copies of advertisements, published in 1917, which used the trademark. In adjudging the Scholl Company entitled to registration, First Assistant Patent Commissioner Kinnan says:

"Notwithstanding the absence of exhibits showing containers which bear the mark of the applicant and which are identified as having enclosed goods which were actually marketed in 1917, it must be held that the applicant has established adoption and use of its mark by a preponderance of evidence from a date established by opposer.

"The methods of conducting commercial enterprises as usually and ordinarily followed must be considered in determining the evidential value of the publications disclosing the applicant's mark in 1917. It is contrary to such ordinary and usual methods of procedure for a manufacturing company to advertise its goods under a trademark which is not actually being used upon the goods and which is not so used for several years after the advertisement."

In other words, the First Assistant Commissioner holds, if you advertise there are sure to be sales, and if you have sales you are using your trademark.

### Court Fines for Imitators

WHEN customers in Los Angeles recently stopped buying the well-known Pequot brand of sheets and pillow cases from the authorized jobbers, saying they could purchase them elsewhere at a lower figure, suspicions were aroused which led to criminal action being instituted by the District Attorney in Los Angeles. The complainants were the Naumkeag Steam Cotton Company and Parker, Wilder Company. Upon pleading guilty to using counterfeit Pequot labels, selling through fraudulent and deceptive advertising, and selling seconds and rejected goods without proper description, the members of the guilty firm, J. E. Hubbard and P. M. Crawford, trading as the Pullman Linen Company, were fined 800 dollars and sentenced to 120 days in prison. Imposition of the jail sentences, however, was suspended.

Such frauds, by which the public is imposed upon and honest manufacturers are injured, are all too common. Civil suits for damages usually are of no avail, for the defendants easily may avoid their effects by going into bankruptcy. A few convictions, however, in criminal courts will do far more to protect the rights of reliable manufacturers of trademarked goods.

### Evidence of Success May Be Evidence of Invention

COMMERCIAL success is one evidence of invention. When the courts are weighing one bit of evidence against another to decide whether what a man did amounts to invention or not, the fact that the public has recognized and rewarded his efforts often tips the scales in his favor.

Such has proved to be the case in the action brought by the Nash Engineering Company against the Trane Company for infringement of patent claims covering vacuum heating devices.

"Vacuum steam heating systems were known as far back as 1882 when Williams took out a patent which may have been the pioneer in this field," Judge Morton, of the Federal District Court for Massachusetts, finds. "During the 35 years which passed before the Jennings application, such systems, notwithstanding their great advantages, do not appear to have gone into very general use.

"One reason for this, apparently, was that there was no satisfactory apparatus for maintaining the vacuum and handling the return-water. Many efforts were made to overcome this difficulty, but without success.

"All the elements which Jennings brought together were old, i.e., vacuum systems were old, a separating tank (or chamber) in such a system with an air-pump and a water-pump was old, rotary pumps for both air and water were old, and in condenser practice both had been mounted on a single shaft and run by the same motor; automatic control of the pumps in a vacuum system was old.

"All this being so, I am still of opinion that the steps which Jennings took involved invention. I am led to this conclusion in part by the immediate and extraordinary success which it achieved in connection with the circumstances under which this success was obtained. The problem which he solved had long been recognized, and the importance of it appreciated. On the solution of it the broad commercial success of vacuum steam heating with the great advantages which it affords depended. But the problem remained unsolved until he accomplished what others had not been able to do. In the relatively short time his apparatus has been on the market some 17,000 installations have been made and it has 'revolutionized' the art.

"It is well settled that this is strong evidence of invention. But when, in a class of machines so widely used as these in question, it is made to appear that at last, after repeated and futile attempts, a machine has been contrived which accomplishes the result desired, and when the Patent Office has granted a patent to the successful inventor, the courts should not be ready to adopt a narrow or astute construction fatal to the grant.

"Where the court has to deal with a device which has achieved undisputed success and accomplishes a result never attained before, which is new, useful and in large demand, it is generally safe to conclude that the man who made it is an inventor."

### Crinkly Cut Tobacco

WILFORD J. HAWKINS applies for a patent, one claim of which is for cigarettes filled with crinkly-cut tobacco and one claim for cutting the tobacco leaves with a serrated-edged knife so that the tobacco shreds will be crinkly instead of straight. With such simple little things as these, is he entitled to a patent?

The Patent Office thought not, but, on appeal to the Court of Appeals of the District of Columbia, the Patent Commissioner was reversed and the claims allowed. Justice Robb writes:

"Applicant has discovered that a saving of more than 10 per centum of the tobacco filler or shreds heretofore required and an improved draft may be effected by making

# Patents Recently Issued

## *Classified Advertising*

*Advertisements in this section listed under proper classifications, rate 25c per word each insertion; minimum number of words per insertion 24, maximum 60. Payments must accompany each insertion.*

*Official copies of any patents listed in this section at 15c each; state patent number to insure receipt of desired patent copy.*

### Pertaining to Apparel

BRASSIERE FOR FORMAL WEAR—Constructed with garter attachments and shoulder straps, and which permits the wearing of very low back evening gowns without exposing a portion of the brassiere. Patent 1649736. W. Rosenthal, 36 W. 57th St., New York, N. Y.

SHAPED SEAMLESS ELASTIC CORSET—A garment made directly on a round knitting machine, and shaped with the diameter varying from one end to the other to produce the desired fit. Patent 1649633. O. C. Wiese, c/o L. Ruberstein, Security Mills, Newton, Mass.

### Chemical Processes

PRESERVATIVE AND PROCESS FOR FORMING THE SAME—For the eradication of any and all parasites, and the preservation of wood articles such as piling, or telegraph posts, subjected to the action of fresh or salt water. Patent 1647937. R. H. Schumacher, 1078 E. Ocean Ave., Long Beach, Calif.

PROCESS OF PRODUCING ANTIFREEZING SOLUTIONS—Which comprises boiling one gallon of calcium chloride solution, approximately thirty degrees Baume, and three ounces of Indian beans, commonly known as castor oil. Patent 1649261. G. A. Schultheiss, 3402 State Ave., Kansas City, Kansas.

PROCESS FOR DESTRUCTIVE DISTILLATION OF HYDROCARBONS—Whereby rapid distillation of hydrocarbon formations such as petroleum, shale, coal and the like, may take place in such manner as to form lighter distillate such as gasoline, benzene and naphtha. Patent 1647026. C. W. Turner, c/o Miss C. T. Turner, St. George Hotel, Clark St., Brooklyn, N. Y.

### Designs

DESIGN FOR A VENDING-MACHINE CASING—Patent 73621. C. E. Parker, Chamber of Commerce Bldg., Los Angeles, Calif.

DESIGNS FOR FEATHER-TRIMMED SHOES—The inventor has been granted two ornamental designs for a feather trimming for shoes. Patents 73808 and 73809. E. Veran, c/o Golo Slipper Co., 129 Duane St., New York, N. Y.

DESIGN FOR TABLE DOILY AND TABLE COVER—The inventor has been granted two patents for ornamental designs. Patents 73650 and 73651. A. L. Ejk, Oak Tree Ave., So. Plainfield, N. J.

DESIGN FOR A PIANO COVER OR THE LIKE—Patent 73652. A. L. Ejk, Oak Tree Ave., So. Plainfield, N. J.

DESIGN FOR LACE—The inventor has been granted four patents on ornamental designs for lace. Patents 73681-2-3 and 73684. B. A. Ball, c/o American Textile Co., Box 671, Pawtucket, R. I.

the cigarette of a wrapped filler containing crinkly shreds of tobacco.

"Applicant was the first to practice this method and the first to produce a cigarette made 'of shreds cut on crinkly lines from assembled tobacco leaves.' The position of the Patent Office is that all tobacco leaves, either fresh or cured, are by nature curved or crinkled. But conceding this to be measurably true, we think it apparent that tobacco prepared by applicant's method, that is cut with a knife having a serrated surface and edge, will be quite different in structure from that cut with a straight knife as heretofore.

"Tobacco cut on straight lines tends to remain in parallel layers, while crinkly tobacco naturally will tend to maintain the shreds in a fluffy condition. We therefore think that the term 'crinkly-cut' distinguishes applicant's shreds from the shreds of the ordinary cigarette. This term originated with him and should be given a meaning in harmony with his disclosure.

"That a single invention may include process and product, where both are new, is familar law. Being of the view that applicant has produced both a new method and a product, we think he is entitled to adequate protection."

## Face Powders and Skin Bleaches

FREDERICK A. MARSEK devised a new cosmetic compound by mixing together a face powder and a skin bleach. Assuming this has not been done before, is he entitled to a patent?

He is not. The ingredients of the face powder are old; so are the ingredients of the skin bleach. The action of the face powder is not modified or changed in any way by the presence of the face bleach and vice versa. It may be more convenient to mix or assemble the substances, but that does not involve invention.

"The mere mixing of ingredients, broadly speaking," the Examiners-in-Chief rule, "cannot form the basis of a patentable process nor can patentability be predicted on a recitation of a result."

## "Smilin' Through" to 250 Dollars Damages

INTO a drug store in Lenoir City, Tennessee, walked a young man named Williams, operator of the player piano of the Grand Motion Picture Theater nearby.

"Will you lend me some music rolls?" he asked his friend, the proprietor.

"Certainly, help yourself," replied the druggist.

Williams returned to the theater, his arms laden with music rolls, and started the evening's entertainment. A little while later a man named Frank J. McGhee strolled up to the box office, bought a ticket and went inside. As the picture unfolded, one tune after another was ground out on the player piano. Among them was one called "Smilin' Through."

Now it happens that that particular song was composed by Arthur A. Penn, who assigned it to M. Witmark & Son, music publishers, who had copyrighted the words and music. The publishers are members of the American Society of Composers, Authors and Publishers, and Mr. McGhee happened to be the society's attorney. It was quite natural, therefore, that R. M. Calloway, owner of the Grand Theater, should be sued for infringement, although of not a single one of the facts stated heretofore in this little account did he have the slightest knowledge.

"Assuming that the defendant did not intend to infringe, the lack of intention does not affect the fact of liability," said Judge Hicks of the United States District Court for Eastern Tennessee. "The result and not the intention determines the question of infringement.

"Neither does the fact, if it is a fact, that young Williams, the operator of the player piano, borrowed this music without the direction, knowledge or consent of the owner or the manager of the theater, affect the question. The rule of the common law applies, to wit: That the master is civilly liable in damages for the wrongful act of his servant in the transaction of the business which he was employed to do, although the particular act may have been done without the express authority from the master, or even against his orders.

"While there does not appear to be any immediate danger of further infringements, yet I am of the opinion that the injunction should issue as a recognition of plaintiff's technical right under Section 25 of the copyright statute.

"The damages indicated in the proof are small, but cannot be fixed at less than 250 dollars, and they are, therefore, fixed at that sum."

DESIGN FOR A LADY'S HAT—Patent 73763. G. H. Simon, c/o Simon Millinery Co., 65 W. 39th St., New York, N. Y.

DESIGN FOR A WOVEN FABRIC OR SIMILAR ARTICLE—The inventor has been granted two patents 73638 and 73639. L. Bluhm, c/o Phœnix Mfg. Co., 40 Thomas St., New York, N. Y.

DESIGN FOR A GRILLE—Patent 73769. G. W. Ackerman, 226 Naples Terrace, New York, N. Y.

DESIGN FOR A NECKTIE HOLDER—Patent 73798. J. C. Miller, 1656 No. Campbell Ave., Chicago, Ill.

### Electrical Devices

RADIO TRANSFORMER—Which comprises a spherical coil acting as a secondary, and a ring-like woven primary disposed around a great circle periphery of the secondary. Patent 1647094. A. P. Hinsky, c/o E. A. Weeks, 8428 114th St., Richmond Hill, L. I., N. Y.

ELECTRIC SWITCH—Constructed to be utilized either as a two-pole or three-pole switch, and to make possible the operation of the switch without the characteristic noise. Patent 1646440. A. J. Ashford, Kinston, N. C.

CONNECTOR—Which affords a secure though readily releasable connection between the vacuum tube of radio apparatus and its socket utilizing mercury as the electrical connecting medium. Patent 1648605. E. H. Bobo, 431 Bobo Ave., Ranger, Texas.

SEPARABLE ATTACHMENT PLUG—In which the bayonet cap is locked to the plug to prevent the accidental removal of the cap until the operator so desires. Patent 1648351. A. H. Kline, 3581 Medill Ave., Chicago, Ill.

WAFFLE IRON—Comprising three superposed mold sections, the intermediate section having upper and lower mold surfaces, adapted to be electrically heated. Patent 1648335. C. M. Cole, 6201 Auburn Ave., Oakland, Calif.

ELECTRICAL WATER—HEATING UNIT—Comprising a pair of spaced electrodes, one supported for manual adjustment, and a themostat supporting the other to vary the distance between them according to temperature change. Patent 1648588. M. Nerew, Winchester, Ill.

### Of Interest to Farmers

HAY PILER—Having means for collecting hay in separate swarths in such a manner that the hay in one swarth is not mixed with the hay in another swarth. Patent 1647064. H. C. Vance, c/o Hitchcock Motor Co., Boise City, Idaho.

CLEANING MACHINE FOR FRUIT, VEGETABLES, OR THE LIKE—Which effectually subjects the entire surface of each piece to a rotary brushing action, and finally feeds the fruit to a sacking mechanism. Patent 1646701. A. O. Moe, Toppenish, Wash.

SHIPPING BOX FOR CHICKENS—Which will permit sufficient circulation of air for small chickens, yet prevent their escape and will take a minimum amount of space during storage. Patent 1647018. F. W. Ruebensaal, c/o Rock River Hatchery, Rockford, Ill.

ATTACHMENT FOR BINDERS—For holding the springs in proper position so that the packers can work the grain snugly, and the butter make a perfect bundle out of long or short grain. Patent 1648621 C. J. Polchow. Bridgewater, S. D.

### Of General Interest

VANITY CASE AND EJECTOR THEREFOR—Wherein the compact is held against accidental removal, while subject to quick removal upon the action of the ejector. Patent 1647046. W. G. Kendall, 118 Market St., Newark, N. J.

## Leaves and Ferns

FOR years John Wanamaker, of Philadelphia, has been using the trademark "Redleaf" for silks, clothing, shoes, underwear, and soaps. When it sought recently, however, to register the mark for corsets, the Warner Brothers Company objected, asserting that it too closely resembled their trademark "Redfern."

"The two marks," says the decision of the Patent Office, "when each is viewed in its entirety, possess considerable similarity which would seem to outweigh their differences. A purchaser does not have both marks simultaneously presented for comparison, but often has a mere recollection of a mark. Under such conditions it would seem that some confusion is probable."

## A Patent for a Grand Stand

COULD you get a design patent on anything as big as a grand stand? "No," said the Patent Commissioner. "Yes," said the Court of Appeals of the District of Columbia, declaring Garvin Hadden entitled to a patent.

The Patent Commissioner's decision was based on the belief that nothing so big as a grand stand could be classed as an article of manufacture.

"It is difficult to attempt a definition of an article of manufacture," he said. "Curiously enough, if the grand stand as made by appellant were of a toy character, one that could be picked up and carried around, purchased in a store and carried home or delivered by the use of a delivery vehicle, the device would be an article of manufacture."

"But," says Justice Robb, writing the opinion for the court, "as pointed out by the court in the Riter-Conley Manufacturing Company case, size and immobility do not determine the question. We are of the opinion that the applicant has produced a new, original and ornamental design for an article of manufacture and is entitled to a patent therefor."

P. S. He got the patent.

CONDIMENT HOLDER—For separately or simultaneously dispensing condiments such as salt and pepper, composed of a minimum number of parts readily assembled or disassembled for cleaning. Patent 1646322. W. P. Smith, 822 South 3rd Ave., Tuscon, Arizona.

LINE TIGHTENER—By means of which a clothes line may be kept substantially taut, a slight pull on one end of the line tightening or releasing the same. Patent 1646336. M. A. Alfano and S. Bohenek, c/o M. A. Alfano, 85 Westminster Ave., Garfield, N. J.

APPARATUS FOR DECORATING INTERIORS—Such as walls and ceilings of rooms, by a combination of tinting, stenciling and embossing effects, employed simultaneously upon the surface. Patent 1644238. F. F. Conwill, 5101 Kenmore Ave., Chicago, Ill.

COLLAPSIBLE SHOEHORN—Which may be collapsed longitudinally and laterally, providing a device not larger than an ordinary key, conveniently carried in the pocket. Patent 1645605. R. E. Lunday, El Rey Hotel, 6th and San Pedro St., Los Angeles, Calif.

SMOKERS RECEPTACLE—For cigarettes, cigars, and ashes, having incorporated therein simple and effective means by which lighted cigarettes can be easily extinguished without burning the fingers. Patent 1644245. W. A. Freeman, Aptmt. 4, 144 North Los Robles, Pasadena, Calif.

BUILDING CONSTRUCTION—Comprising a form for supporting concrete floors while said flooring is hardening, whereby there is no possibility of concrete escaping. Patent 1646450. W. G. Forkey, 4203 W. Madison St., Chicago, Ill.

SWING—Adapted for use as a cradle, made up of strands of rattan or wire, may be supported by cables, and safely used by very young children. Patent 1646716. F. H. Wheeler, Box 124, Tucson, Ariz.

FISH TRAP—Which can be used repeatedly to snare and retain garfish of different sizes so that they cannot accidentally escape but can be readily removed. Patent 1647027. L. Wagner, 200 Jefferson St., Jefferson City, Mo.

FELT BATT—Folded in a particular manner so that no seams will be noted in the felt, as used in filling for fluted seat cushions of automobiles. Patent 1647022. H. M. Scott, Box 860, Chickasha, Oklahoma.

DIRECTORY—Wherein means are had for visually distinguishing any particular portion of a map or chart, from all other portions, for studying or reading Patent 1637685. C. E. Cowles, 112 Caine St., Battle Creek, Mich.

CANDLE SUPPORT—In the form of a sheet of roughened material readily attached to a candle for firmly holding the same in the candlestick socket. Patent 1647898. E. L. Bearse, P. O. Box 94, Centerville, Mass.

COMPACT EJECTOR FOR VANITY CASES—Which will act in the double capacity of means for holding a compact in place and means for removing the compact. Patent 1647917. W. G. Kendall, 118 Market St., Newark, N. J.

SWIMMING DEVICE—Adapted to be worn comfortably and without interfering with body movement, adjustable to fit wearers of different sizes, can be folded into small space. Patent 1647875. K. B. Martin, 222 W. Commercial St., Springfield, Mo.

POWDER CONTAINER—For conveniently carrying and dispensing face powder in loose form, and preventing the accidental sifting of the powder when carried in a hand bag or pocket. Patent 1647886. G. L. Ravit, R. F. D. Prince Bay, Annadale, S. I., N. Y.

FIRE EXTINGUISHER—Which will effectively prevent leakage of the chemicals, but automatically discharge them under pressure when the container is inverted from its normal position. Patent 1647880. C. Lervein, c/o Smith & Wild, 209 McCandles Bldg., Honolulu, H. I.

RAIN CATCHER—Which when not in use may be closed, so as to exclude dust and foreign particles, when it is desired to open it for catching water. Patent 1647900. G. C. Carpenter, 16 Court St., White Plains, N. Y.

PORTABLE CONTAINER—Which is strong and durable to withstand roughest usage, will permit flat stacking in numbers, the contents being readily accessible when containers are stacked. Patent 1645992. C. Hinde, P. O. Box A, Wilmington, Calif.

DIVING SINKER FOR DEEP-SEA ANGLING—Which automatically operates to cause the spinner or bait to dive and remain submerged irrespective of the boat speed or length of the trolling line. Patent 1645874. C. B. Sanford, Box 1236, Avalon, Calif.

COSMETIC-PAD HOLDER—Whereby a compact may be held in place without glue or other adhesive, the gripping means being integral with the holder. Patent 1647916. W. G. Kendall, 118 Market St., Newark, N. J.

DISPLAY APPARATUS—In which an assortment of hosiery of different colors may be displayed to prospective customers who may select the desired color without handling the goods. Patent 1649652. G. G. Beckhardt, 475 17th St., Brooklyn, N. Y.

COMBINATION FOUNTAIN AND AQUARIUM—Which may be employed as either an aquarium or lily pond, and embodies means for producing attractive lighting effects when the fountain is in operation. Patent 1649683. C. W. Goodsman, 1521 Fremont St., Portland, Ore.

BUILDING BLOCK—Having inclined end meeting faces which facilitate the retention of the mortar and insure a weather-proof wall. Patent 1649780. I. Robbins, 91 West 39th St., Bayonne, N. J.

SUPPORT FOR WINDOW SHADES AND CURTAINS—Capable of being shifted and adjusted with respect to a window frame to which it is attached to facilitate the cleaning of the window panes. Patent 1649717. Helen Machowicz, 147-18 Brinkerhoff Ave., Jamaica, N. Y.

BABY'S BED—Having means for collecting and absorbing moisture, for fastening the bed clothes to prevent removal by the child, and a removable frame to prevent the child falling. Patent 1649754. W. L. Summerson, 285 W. 4th St., New York.

ENVELOPE OPENER—Adapted for use in connection with a finger ring, and may be used while on the finger to perform its functions. Patent 1649699. A. R. Irvine, General Delivery, Albany, N. Y.

PACKAGE—Particularly adapted for holding cigarettes, easily opened for the removal of the cigarettes, and with means for preventing crushing of the last few within the package. Patent 1649692. C. E. Hemminger, 138 E. Patriot St., Somerset, Pa.

FRUIT-JUICE EXTRACTOR—By means of which practically all the juice can be removed from citrus or other suitable fruit, and imbibed direct from the extractor. Patent 1649755. A. W. Thompson, 2194 N. W. 47th Terrace Miami, Fla.

COLLAPSIBLE HATBOX—Which when extended functions as the usual hatbox to protect the contents but when collapsed will occupy a minimum space for storage. Patent 1647679. L. H. Williams, 354½ West 54 St., Los Angeles, Calif.

LAST-BLOCK FASTENER—Wherein the block may be manipulated in the usual manner while the fastener presents a construction which will not readily injure the block. Patent 1649709. S. D. Layman, 22 North 19th St., East Orange, N. J.

SEPARABLE CONNECTER FOR SECTIONAL CONTAINERS AND SUPPORTS—Comprising complemental members with notched tongues arranged for interlocking engagement with each other, adapted for collapsible boxes and crates, or stage scenery. Patent 1648591. T. Repay, 1619½ W. 22nd St., Los Angeles, Calif.

SHUTTING-OFF DEVICE AND VALVE—Which pertains to brake pipe valves and is intended to provide for facility of adjustment and regulating to insure unfailing operation of the parts. Patent 1649735. O. Roschanek, c/o Paget, Moeller & Hardy, Riemergasse 6, Vienna, Austria.

DEVICE FOR TREATING CIGARS, CIGARETTES AND THE LIKE—Whereby a substantial amount of moisture may be readily applied, just before smoking, to the interior of the body without unduly wetting the ends. Patent 1648655. A. W. C. Menzies, 187 Prospect Ave., Princeton, N. J.

BUILDING CARD STRUCTURE AND BLANK FOR PRODUCING SAME—Comprising card-board units composed of a central member provided with tabs and other members having in-turned flanges for interlocking the adjacent units. Patent 1648604. S. J. Bedington, c/o Munn, Anderson & Munn, 24 W. 40th St., New York, N. Y.

BUILT-IN FIRE EXTINGUISHER HOLDER—Wherein the holder merges into the molding which in turn merges into an expanded metal portion interlocking with the plaster of the wall. Patent 1648615. L. Lewis, 3224 Grand Concourse, New York, N. Y.

CUE TIP—Having a novel means for securely fastening a billiard cue tip in position by a screw and threaded recess. Patent 1648613. H. J. Grenier, 74 Carlton Ave., Bridgeport, Conn.

PANEL FRAME—For windows, door panels, and the like including a wooden filler and a fabricated outer sheet metal covering having integral flanges. Patent 1648584. R. Gaudard, c/o C. J. Wolf, 525 58th St., Brooklyn, N. Y.

RAZOR-BLADE HOLDER—In which a blade of the safety razor type may be readily inserted and securely held for sharpening or honing, or for use as a knife. Patent 1648618. L. O. McGourty, 1767 Park Ave., New York, N. Y.

COOLER ATTACHMENT—Having a novel form of stirrer which will maintain syrups and other substances more or less thick, in uniform mixture and prevent gravitational separation. Patent 1648594. W. A. Schatz, 173 Ditmars Ave., Astoria, L. I., N. Y.

## Hardware and Tools

COMBINATION SCREW DRIVER AND STARTER—Which allows a blow to be delivered to the shank of the screw driver, for giving an initial movement to the screw, before turning movement is commenced. Patent 1643433. E. Walker, P. O. Box 292, Willows, Calif.

CONCRETE-WORKING TOOL—By means of which spreaders, such as wooden blocks, for holding the form boards in place while concrete is being poured, may be readily removed. Patent 1645873. H. T. Rogers, 1730 E. 70th St., Chicago Ill.

CONNECTING MEANS FOR BED RAILS—A metal corner fastening for securely and detachably connecting the rails and bed frame so as to rigidly hold them together. Patent 1644281. C. H. Ruth, Box 260, Huntington Park, Calif.

METHOD OF MANUFACTURING HORSESHOE CALKS—From high carbon steel wire, by pressing the material while cold to cause the same to flow under the action of the dies employed. Patent 1647076. T. F. Boylan, Sr., c/o Eversharp Mfg. Co., 330 Townsend St., New Brunswick, N. J.

LATCH—Particularly adapted for dumb-waiter doors, which permits the latch to be secured so that it cannot be manipulated from within the elevator shaft. Patent 1647921. J. H. Levinson, 2310 Walton Ave., Bronx, N. Y.

## Heating and Lighting

OIL BURNER—In which the member which contacts with the flame may be readily removed and a new one inserted without the removal of other portions. Patent 1646456. G. Noreen and C. V. Newquist, c/o C. V. Newquist, 446 N. Leamington Ave., Chicago, Ill.

DRIER FOR TUBULAR FABRICS—Which includes a hollow body over which articles such for example as jerseys, silk, cotton and other tubular fabrics may be drawn. Patent 1647449. M. M. Kasanof, 3190 Rochambeau Ave., Bronx, N. Y.

## Machines and Mechanical Devices

FLOTATION MACHINE—Which will efficiently cause separation of mineral ore and foreign matter, and will discharge the froth without any tendency to throw the pulp. Patent 1646351. F. De Mier, 201 Vantage St., Picher, Okla.

AUTOMATIC OPERATING DEVICE FOR STEAM-JET PUMPS OR THE LIKE—Which will automatically limit the rise of water in the receiver by opening the ejector valve when the water reaches a predetermined level. Patent 1645639. W. J. Anderson, 418 40th St., Brooklyn, N. Y.

LIQUID GAUGE—By means of which the amount of gasoline or other liquid in a tank or other vessel can be accurately determined; will withstand rough usage. Patent 1644415. F. Cosgros, 525 Sixth and Acacia Sts., Huntington Beach, Cal.

WAVE MOTOR—A framework to be seated on the bed of the ocean, bay, river or other body of water where the level rises and falls, for obtaining power from the waves. Patent 1647025. F. Stich, 654 E. 12th St., New York, N. Y.

CASING FOR ARTESIAN WELLS—In the form of a perforated cement casing providing a well lining and further providing a means for filtering the water entering the well. Patent 1645719. A. Paulsen, San Carlos, Calif.

WATER WHEEL—Mounted for oscillating and rotational movements, submerged in a manner to fully utilize the water power when moving in either direction to effect rotation. Patent 1645996. F. L. McQuiston, 817 Garnet St., Redondo, Calif.

ROTARY INTAGLIO-PRINTING MACHINE—In which the eccentric bushes are mechanically connected together in such a way that both ends of the cylinder shaft can be moved simultaneously. Patent 1647948. C. Winkler, c/o Winkler, Fallert Co., Bern, Switzerland.

CHANNELING MACHINE—For stone channeling, having improved means for mounting and bracing the chair boards, and a frame construction which renders the entire machine more rugged. Patent 1647885. E. J. Raverty, c/o New Albany Machine Mfg. Co., New Albany, Ind.

WIND MOTOR—Capable of being constructed in any size without sacrificing speed, and will utilize the power of winds blowing in different directions without loss of torque. Patent 1645855. E. E. DeVore, Deer Lodge Park, Twin Peaks, P. O., Calif.

SIRUPING-OFF PAN—So constructed as to reverse the flow of fresh sap each day to remove the malate of lime deposits from the walls of the pan. Patent 1647908. J. C. Fox, 201 Grove St., Rutland, Vt.

WALL-BOARD MACHINE—For automatically feeding the wooden slats where the board is composed of an intermediate layer of slats glued between two layers of heavy paper. Patent 1646645. A. L. Frederickson and E. C. Pitcher, c/o Pacific Tank & Pipe Co., High St., & Canal, Oakland, Calif.

ENGRAVING PROCESS AND DEVICE—Adapted for producing engraved work from copper plates on the usual printing press without the necessity of use of other equipment. Patent 1648782. S. E. Rice, 114 W. 3d St., Tulsa, Okla.

UNIVERSAL JOINT—Which is made of a minimum number of simple strong and durable parts, can be tightened or loosened for adjustment, and quickly assembled or disassembled. Patent 1648624. E. P. Schultz, 843 E. 10th St., Brooklyn, N. Y.

AUTOMATIC STARCHER FOR RAW-GUM MATERIAL—For dusting raw rubber when in sheet form, such as taken from a calender, on both sides and in a continuous and uniform manner. Patent 1648828. W. R. Scott, Box 443, Springdale, Conn.

FABRIC STEAMING AND STRETCHING MEANS—More particularly intended for stretching tubular fabrics to varying degrees in a uniform manner without distorting the designs presented by the fabric. Patent 1648614. M. M. Kasanof, 3190 Rochambeau Ave., New York, N. Y.

PEELER—For removing by heat, or direct contact of flame, the outer skin of fruits, tomatoes, and the like, by passing them through a furnace open at both ends. Patent 1647872. J. Q. Leavitt, P. O. Box 364, Ogden, Utah.

MEASURING FAUCET—Which will function in a manner to positively force viscid syrups from a faucet in various predetermined measured quantities. Patent 1648593. W. A. Schatz, 173 Ditmars Ave., Astoria, L. I., N. Y.

VENDING MACHINE—Of the self-service type, with means for indicating to an attendant that a patron comtemplates making a purchase, and has deposited a coin. Patent 1649658. P. Boals, c/o A. G. Cameron, Marmon Auto Co., 1880 Broadway, New York, N. Y.

GRAVITY BALANCE—For use in determining the specific gravity of gases, wherein the mechanism may be readily adjusted for accuracy without removal from the casing. Patent 1649746. W. A. C. Schlueter, c/o Refinery Supply Co., Tulsa, Okla.

MATRIX-DRYING CABINET AND METHOD OF TREATING MATRICES—Which will permit a desired number of matrices to be dried with a uniform shrinking and without buckling or other damage. Patent 1649647. R. W. Bandy, c/o Post-Intelligencer, Seattle, Wash.

APPARATUS FOR REMOVING SOLID MATTER FROM ROTARY MUD—As used in well drilling, whereby the excessive wear to which the drilling and pumping apparatus are usually subjected, is reduced to a minimum. Patent 1647310. C. C. Richardson, 535 Fourth St., Huron, S. D.

## Prime Movers and Their Accessories

ATTACHMENT FOR GAS ENGINES—For commingling a mixture of air and fuel with the gases from the carbureter between the carbureter and the manifold to produce a more powerful mixture. Patent 1646321. P. F. Siegmann, Box 192, Fort Sam Houston, Texas.

PISTON—For internal combustion engines, in which is incorporated means for expansion, so that a close running fit between piston and cylinder is maintained at all times. Patent 1645256. G. W. Robinson, c/o F. N. Dorland, 810 F. St., San Diego, Calif.

EXPANSIBLE - FLUID MOTOR—Particularly adapted for use as a propelling unit for a motor vehicle wheel, being designed for direct association with each of the wheels of a vehicle. Patent 1645761. J. J. DeLuc, Box 415, Milwaukie, Oregon.

INTERNAL-COMBUSTION ENGINE—Which provides motive power with so few parts and such simple and light construction, and close dimensions over all, that the machine may be carried by an adult. Patent 1648597. I. W. Seward, c/o Jas. C. Williams, c/o Joplin Theater, Joplin, Mo.

INTERNAL - COMBUSTION ENGINE—Having three mechanical units working so as to control the position and speed of the piston as well as the turning force on the crank. Patent 1648141. C. C. Martin, Neihart, Mont.

## Pertaining to Recreation

MAIL-BAG EJECTOR FOR TOY RAILWAYS—Having means for automatically ejecting the bags subsequent to the catching operation, which eliminates the necessity of stopping the train for this purpose. Patent 1646315. F. J. Pullis, 267 Howard Place, Jersey City, N. J.

AIR-OPERATED TOY—Having the general appearance of a rattle with facilities for making use of air to sound a whistle and actuate a movable element simultaneously. Patent 1647902. I. E. Cohn, 117 E. 24th St., New York, N. Y.

FOOTBALL HELMET—Having ear guards with recesses sufficiently deep to fully contain and protect the ears against a blow, by transfering the blow to the skull. Patent 1648850. A. E. Kennedy, c/o Ken Wel Sporting Goods Co., Utica, N. Y.

GAME APPARATUS—Comprising a table with concaved surface, and a plurality of ovate-shaped objects projecting above the table top to be knocked off by a thrown ball. Patent 1649740. W. Rott, 40 E. 9th St., New York, N. Y.

## Pertaining to Vehicles

FOUR-WHEEL BRAKE—Among other features is a plurality of externally mounted springs adapted to maintain the brake band out of engagement with the brake drum. Patent 1646335. A. C. Woodruff, Oakridge, Oregon.

RUNNING GEAR FOR WAGONS—Which eliminates the use of wagon hounds, sway bars and the like by the provision of a flexible joint between the front and rear axle assemblies. Patent 1647047. F. M. Kennedy, c/o Kennedy Mfg. Co., Clarendon, Ark.

RESILIENT TIRE—Which includes a plurality of spring members disposed on the rim of a wheel between the wheel rim and an annular tread member supporting ring. Patent 1647871. P. A. Lea, c/o Mrs. V. L. Henderson, 401 New Orleans Bank Bldg., New Orleans, La.

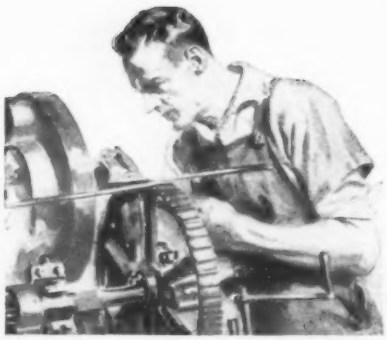
ADJUSTING DEVICE FOR BRAKE-ACTUATING MECHANISM—For adjusting the mechanism of vehicle brakes so that depression of the brake pedal will cause proper brake application. Patent 1646012. G. W. Cook, 3917 Mentor Ave., Los Angeles, Calif.

GREASE GUN—For feeding lubricant under pressure in predetermined quantities to bearings or other parts of vehicles or machinery, normally closed against the escape of lubricant. Patent 1647941. N. Story, 3rd, Bozeman, Mont.

DIRECTION INDICATOR—Supported from an automobile windshield and having an indicating device in the form of a hand, wholly located within a casing, but easily extended for signaling. Patent 1648579. G. A. Cummings, c/o A. G. Sharkey, 1021 Paulson Bldg., Spokane, Wash.

GROUSER—Which is particularly strong and is of wedge-shaped form, adapted to be used in connection with the traction wheels of a tractor. Patent 1647019. T. G. Schmeiser, 14045 Hobart Bldg., San Francisco, Calif.

AUTOMOBILE SANDER—Manually controlled by the driver to discharge sand immediately in the path of the driving wheels for checking skidding upon icy or slippery streets. Patent 1648623. E. P. Rovinson, 1440 Broadway, New York, N. Y.



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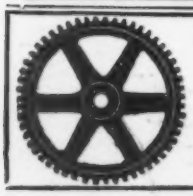

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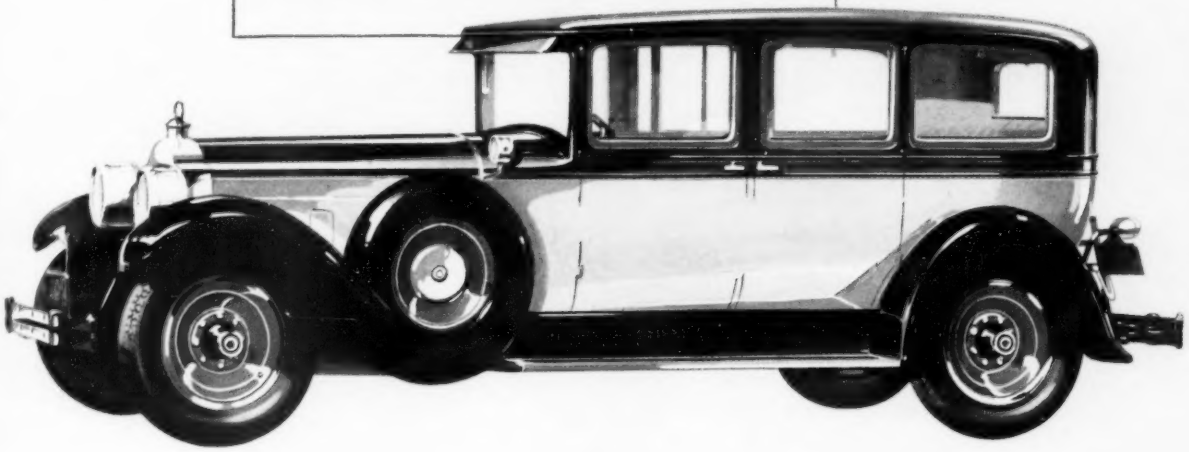

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